ANDHRA UNIVERSITY

DEPARTMENT OF MARINE ENGINEERING

B.TECH(NAVAL ARCHITECTURE & MARINE ENGINEERING)

REGULATION AND SYLLABUS

EFFECTIVE FROM 2021-2022 BATCH
## B.Tech 1 Year - I Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM1101</td>
<td>BS</td>
<td>Mathematics – I</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1102</td>
<td>BS</td>
<td>Physics</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1103</td>
<td>ES</td>
<td>Engineering Graphics</td>
<td>2 3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1104</td>
<td>ES</td>
<td>Introduction to Physical oceanography</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1105</td>
<td>ES</td>
<td>Introduction to Naval Architecture</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1106</td>
<td>ES</td>
<td>Workshop</td>
<td>0 3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1107</td>
<td>BS</td>
<td>Physics Lab</td>
<td>0 3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1108</td>
<td>ES</td>
<td>Ship Welding Lab</td>
<td>0 3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Total Credits**: 19.5

## B.Tech 1 Year - II Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM1201</td>
<td>BS</td>
<td>Mathematics – II</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1202</td>
<td>BS</td>
<td>Chemistry</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1203</td>
<td>HSS</td>
<td>English</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1204</td>
<td>ES</td>
<td>Computer programming and Numerical Methods</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1205</td>
<td>ES</td>
<td>Basic Ship Theory</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1206</td>
<td>HSS</td>
<td>English Language Lab</td>
<td>0 3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1207</td>
<td>BS</td>
<td>Chemistry Lab</td>
<td>0 3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1208</td>
<td>ES</td>
<td>Computer programming and Numerical Methods Lab</td>
<td>0 3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Total Credits**: 19.5
## B. Tech (Naval Architecture and Marine Engineering)

### B. Tech - II Year - I Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 2101</td>
<td>BS</td>
<td>Mathematics - III</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2102</td>
<td>PC</td>
<td>Engineering Mechanics – I (Statics)</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2103</td>
<td>PC</td>
<td>Mechanics of Materials - I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2104</td>
<td>PC</td>
<td>Basic Thermodynamics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2105</td>
<td>HSS</td>
<td>Managerial Economics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2106</td>
<td>PC</td>
<td>Computer Aided Ship Design Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2107</td>
<td>PC</td>
<td>Mechanics of Materials Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2108</td>
<td>PC</td>
<td>Ship Drawing - I</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2109</td>
<td>SC</td>
<td>DelftShip Software Practice</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2110</td>
<td>MC</td>
<td>Professional Ethics &amp; Universal Human Values</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>NM 2111</td>
<td>MC</td>
<td>NSS/NCC</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total Credits** 21.5

### B. Tech -II Year- II Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 2201</td>
<td>ES</td>
<td>Electrical Technology</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2202</td>
<td>BS/P C</td>
<td>Eng. Mechanics – II (Dynamics)</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2203</td>
<td>PC</td>
<td>Mechanics of Materials - II</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2204</td>
<td>PC</td>
<td>Engineering Thermodynamics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2205</td>
<td>PC</td>
<td>Material Science</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2206</td>
<td>PC</td>
<td>Electrical Tech Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2207</td>
<td>PC</td>
<td>AutoCAD Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2208</td>
<td>SC</td>
<td>Intellectual Property Rights</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2209</td>
<td>MC</td>
<td>Environmental Science</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Total credits** 20

Internship I
### B. Tech - III Year- I Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>Ext Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 3101</td>
<td>PC</td>
<td>Fluid Mechanics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3102</td>
<td>PC</td>
<td>Ship Design - I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3103</td>
<td>PC</td>
<td>Ship Construction</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3104</td>
<td>PE</td>
<td>Professional Elective I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3105</td>
<td>PE</td>
<td>Marine Thermal Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3106</td>
<td>PE</td>
<td>Marine Hydrodynamics Lab</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3107</td>
<td>SC</td>
<td>Welding Practice</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3108</td>
<td>INT</td>
<td>Internship-I</td>
<td></td>
<td></td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total credits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22</td>
</tr>
</tbody>
</table>

### B. Tech -III Year- II Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>Ext Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 3201</td>
<td>PC</td>
<td>Resistance and Propulsion</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3202</td>
<td>PC</td>
<td>Strength of Ships</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3203</td>
<td>PC</td>
<td>Ship Design - II</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3204</td>
<td>PE</td>
<td>Professional Elective II</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3205</td>
<td>OE</td>
<td>Open Electives II</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3206</td>
<td>PC</td>
<td>Marine Hydrodynamics Lab</td>
<td>0</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3207</td>
<td>PC</td>
<td>Marine Instrumentation and Metrology lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3208</td>
<td>PC</td>
<td>Ship Drawing - III</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3209</td>
<td>SC</td>
<td>Soft Skills</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total credits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21.5</td>
</tr>
</tbody>
</table>

<p>|              |          | <strong>Internship II</strong>          |                |                |           |             |         |         |</p>
<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Int Marks</th>
<th>Ext Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NM 4101</td>
<td>PE</td>
<td>Professional Elective III</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4102</td>
<td>PE</td>
<td>Professional Elective IV</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4103</td>
<td>PE</td>
<td>Professional Elective V</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4104</td>
<td>OE</td>
<td>Open Electives III</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4105</td>
<td>OE</td>
<td>Open Electives IV</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4106</td>
<td>HSS</td>
<td>Elective</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4107</td>
<td>SC</td>
<td>Advanced NAPA Lab</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM4108</td>
<td>INT</td>
<td>Internship-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total credits 22

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 4201</td>
<td>PROJ.</td>
<td>Project work</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>14</td>
</tr>
</tbody>
</table>

Total credits 14

B. Tech -IV Year- II Semester
Professional Electives:
I. Intro to Offshore structures
II. Ocean Structures & materials
III. FEA
IV. Marine Manufacturing Technology
V. Fishing Vessel Technology
VI. Marine Hydrodynamics
VII. Advanced Welding Technology
VIII. sea keeping and maneuverability
IX. Dynamics of Offshore Structures
X. Design of Small Crafts
XI. Naval Vessels
XII. Advanced Ship Theory
XIII. Under Water Acoustics
XIV. Marine Engineering II
XV. Advanced Fluid Mechanics

Open Electives:
I. Industrial Electronics
II. NAPA /Rhino /Exact Flat Lab
III. Marine Instrumentation and Control
IV. Ship Vibrations
V. CASD
VI. Underwater Acoustics
VII. Ship Construction
VIII. Experimental Hydrodynamics
IX. Marine Power plant Engineering
X. Sub Sea Piping
XI. Marine Engineering I
XII. Hydrodynamics and computational Methods

HSS Electives
I. Organization Behavior
II. Industrial management and Entrepreneur
III. Operations Research
<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM1101</td>
<td>BS</td>
<td>Mathematics – I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1102</td>
<td>BS</td>
<td>Physics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1103</td>
<td>ES</td>
<td>Engineering Graphics</td>
<td>2</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1104</td>
<td>ES</td>
<td>Introduction to Physical oceanography</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1105</td>
<td>ES</td>
<td>Introduction to Naval Architecture</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1106</td>
<td>ES</td>
<td>Workshop</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 1107</td>
<td>BS</td>
<td>Physics Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 1108</td>
<td>ES</td>
<td>Ship Welding Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

**Total Credits**: 19.5
B.Tech. (Naval Architecture and Marine Engineering)

Programme Outcomes:

At the end of the Programme the student will become

PO1. Graduates of the program are to have demonstrated the ability to direct, supervise, and make important decisions regarding the design and engineering of problems based on engineering fundamentals and modern technological tools in Naval Architecture and Marine Engineering.

PO2. Graduates of the program are to have demonstrated the maturity and knowledge needed for participating in the leadership of the advancement of the NAME field.

PO3. Basic knowledge of fluid mechanics, dynamics, structural mechanics, material properties, hydrostatics, and energy/propulsion systems in the context of marine vehicles.

PO4. Familiarity with instrumentation appropriate to naval architecture and marine engineering.

PO5. An ability to use the techniques, skills, and modern engineering tools necessary for naval architecture practice.

PO6. Acquire innovative and creative thinking skills to augment their professional growth.

PO7. Pursue higher education and research in marine sector, other engineering streams and specializations.

PO8. Build their career as a successful and distinguished Naval Architect, Marine Engineer, and Offshore and Onshore Engineer.

Programme Specific Outcomes:

PSO1. Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, materials and mathematics.

PSO2. Attain knowledge to carry out the watch keeping duties of an engineer officer on board a ship in a safely manner.

PSO3. To provide hands on training in specific technical courses so that the graduates can develop the skills to work as a team and gain leadership skills and also readily employable or become an entrepreneur.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L  P</td>
<td>Internal Marks</td>
<td>External Marks</td>
<td>Total Marks</td>
<td></td>
</tr>
<tr>
<td>NM1101</td>
<td>BS</td>
<td>Mathematics – I</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1102</td>
<td>BS</td>
<td>Physics</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1103</td>
<td>ES</td>
<td>Engineering Graphics</td>
<td>2  3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1104</td>
<td>ES</td>
<td>Introduction to Physical oceanography</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1105</td>
<td>ES</td>
<td>Introduction to Naval Architecture</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1106</td>
<td>ES</td>
<td>Workshop</td>
<td>0  3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1107</td>
<td>BS</td>
<td>Physics Lab</td>
<td>0  3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1108</td>
<td>ES</td>
<td>Ship Welding Lab</td>
<td>0  3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Credits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L  P</td>
<td>Internal Marks</td>
<td>External Marks</td>
<td>Total Marks</td>
<td></td>
</tr>
<tr>
<td>NM1201</td>
<td>BS</td>
<td>Mathematics – II</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1202</td>
<td>BS</td>
<td>Chemistry</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1203</td>
<td>HSS</td>
<td>English</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1204</td>
<td>ES</td>
<td>Computer programming and Numerical Methods</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1205</td>
<td>ES</td>
<td>Basic Ship Theory</td>
<td>4  0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1206</td>
<td>HSS</td>
<td>English Language Lab</td>
<td>0  3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1207</td>
<td>BS</td>
<td>Chemistry Lab</td>
<td>0  3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1208</td>
<td>ES</td>
<td>Computer programming and Numerical Methods Lab</td>
<td>0  3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Credits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.5</td>
</tr>
</tbody>
</table>
# B. Tech (Naval Architecture and Marine Engineering)

## B. Tech - II Year - I Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 2101</td>
<td>BS</td>
<td>Mathematics - III</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2102</td>
<td>PC</td>
<td>Engineering Mechanics – I (Statics)</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2103</td>
<td>PC</td>
<td>Mechanics of Materials - I</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2104</td>
<td>PC</td>
<td>Basic Thermodynamics</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2105</td>
<td>HSS</td>
<td>Managerial Economics</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2106</td>
<td>PC</td>
<td>Computer Aided Ship Design Lab</td>
<td>0 L 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM 2107</td>
<td>PC</td>
<td>Mechanics of Materials Lab</td>
<td>0 L 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM 2108</td>
<td>PC</td>
<td>Ship Drawing - I</td>
<td>0 L 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM 2109</td>
<td>SC</td>
<td>DelftShip Software Practice</td>
<td>1 L 2 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>NM 2110</td>
<td>MC</td>
<td>Professional Ethics &amp; Universal Human Values</td>
<td>0 L 0 P</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>NM 2111</td>
<td>MC</td>
<td>NSS/NCC</td>
<td>0 L 2 P</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total Credits** 21.5

## B. Tech - II Year - II Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 2201</td>
<td>ES</td>
<td>Electrical Technology</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2202</td>
<td>BS/P C</td>
<td>Eng. Mechanics – II (Dynamics)</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2203</td>
<td>PC</td>
<td>Mechanics of Materials - II</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2204</td>
<td>PC</td>
<td>Engineering Thermodynamics</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2205</td>
<td>PC</td>
<td>Material Science</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2206</td>
<td>PC</td>
<td>Electrical Tech Lab</td>
<td>0 L 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM 2207</td>
<td>PC</td>
<td>AutoCAD Lab</td>
<td>0 L 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM 2208</td>
<td>SC</td>
<td>Intellectual Property Rights</td>
<td>1 L 2 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>NM 2209</td>
<td>MC</td>
<td>Environmental Science</td>
<td>0 L 0 P</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total credits** 20

**Internship I**
### B. Tech - III Year- I Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 3101</td>
<td>PC</td>
<td>Fluid Mechanics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3102</td>
<td>PC</td>
<td>Ship Design - I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3103</td>
<td>PC</td>
<td>Ship Construction</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3105</td>
<td>PE</td>
<td>Professional Elective I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3104</td>
<td>OE</td>
<td>Open Electives I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3106</td>
<td>PC</td>
<td>Marine Thermal Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3107</td>
<td>PC</td>
<td>NAPA Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3108</td>
<td>SC</td>
<td>Welding Practice</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3109</td>
<td>INT</td>
<td>Internship-I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total credits**: 22

### B. Tech - III Year- II Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 3201</td>
<td>PC</td>
<td>Resistance and Propulsion</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3202</td>
<td>PC</td>
<td>Strength of Ships</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3203</td>
<td>PC</td>
<td>Ship Design - II</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3204</td>
<td>PE</td>
<td>Professional Elective II</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3205</td>
<td>OE</td>
<td>Open Electives II</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3206</td>
<td>PC</td>
<td>Marine Hydrodynamics Lab</td>
<td>0</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3207</td>
<td>PC</td>
<td>Marine Instrumentation and Metrology lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3208</td>
<td>PC</td>
<td>Ship Drawing - III</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3209</td>
<td>SC</td>
<td>Soft Skills</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

**Total credits**: 21.5

**Internship II**
### B. Tech - IV Year - I Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Int Marks</th>
<th>Ext Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 4101</td>
<td>PE</td>
<td>Professional Elective III</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 4102</td>
<td>PE</td>
<td>Professional Elective IV</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 4103</td>
<td>PE</td>
<td>Professional Elective V</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 4104</td>
<td>OE</td>
<td>Open Electives III</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 4105</td>
<td>OE</td>
<td>Open Electives IV</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 4106</td>
<td>HSS</td>
<td>Elective</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 4107</td>
<td>SC</td>
<td>Advanced NAPA Lab</td>
<td>1 L 2 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>NM 4108</td>
<td>INT</td>
<td>Internship-II</td>
<td>5 L 0 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>2</td>
</tr>
</tbody>
</table>

Total credits **22**

### B. Tech - IV Year - II Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 4201</td>
<td>PROJ.</td>
<td>Project work</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>14</td>
</tr>
</tbody>
</table>

Total credits **14**
Professional Electives:

I. Intro to Offshore structures
II. Ocean Structures & materials
III. FEA
IV. Marine Manufacturing Technology
V. Fishing Vessel Technology
VI. Marine Hydrodynamics
VII. Advanced Welding Technology
VIII. Sea keeping and maneuverability
IX. Dynamics of Offshore Structures
X. Design of Small Crafts
XI. Naval Vessels
XII. Advanced Ship Theory
XIII. Under Water Acoustics
XIV. Marine Engineering II
XV. Advanced Fluid Mechanics

Open Electives:

I. Industrial Electronics
II. NAPA/Rhino/Exact Flat Lab
III. Marine Instrumentation and Control
IV. Ship Vibrations
V. CASD
VI. Underwater Acoustics
VII. Ship Construction
VIII. Experimental Hydrodynamics
IX. Marine Power plant Engineering
X. Sub Sea Piping
XI. Marine Engineering I
XII. Hydrodynamics and computational Methods

HSS Electives

I. Organization Behavior
II. Industrial management and Entrepreneur
III. Operations Research
### B.Tech I Year - I Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 1101</td>
<td>BS</td>
<td>Mathematics – I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1102</td>
<td>BS</td>
<td>Physics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1103</td>
<td>ES</td>
<td>Engineering Graphics</td>
<td>2</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1104</td>
<td>ES</td>
<td>Introduction to Physical oceanography</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1105</td>
<td>ES</td>
<td>Introduction to Naval Architecture</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 1106</td>
<td>ES</td>
<td>Workshop</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 1107</td>
<td>BS</td>
<td>Physics Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 1108</td>
<td>ES</td>
<td>Ship Welding Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

**Total Credits** 19.5
Course Objectives: The contents of this course fulfill the fundamental requirements of knowledge of Mathematics for learning Engineering subjects. The main objectives of student learning are:

- To transmit the knowledge of Partial differentiation.
- To know of getting maxima and minima of function of two variables and finding errors and approximations.
- To evaluate double and triple integrals, volumes of solids and area of curved surfaces.
- To expand a periodical function as Fourier series and half-range Fourier series.

Course Outcomes: At the end of this course, the student will understand and be able to apply the basic principles of differential and integral calculus to various engineering problems. Particularly, the student will be able to

- Find the partial derivatives of functions of two or more variables.
- Evaluate maxima and minima, errors and approximations.
- Evaluate double and triple integrals, volumes of solids and area of curved surfaces.
- To expand a periodical function as Fourier series and half-range Fourier series.
- Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

SYLLABUS

Partial Differentiation, Multiple Integrals, Fourier series and Their Applications

(Partial Differentiation)
Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler’s theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs)

(Applications of Partial Differentiation)
Geometrical interpretation - Tangent plane and Normal to a surface - Taylor’s theorem for functions of two variables - Errors and approximations - Total differential. Maxima and Minima of functions of two variables - Lagrange’s method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz’s rule.

(Multiple Integrals)
Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

(Multiple Integrals - Applications)

(Fourier Series)
Introduction - Euler’s Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval’s Formula. Practical Harmonic analysis.

TEXT BOOK:

REFERENCE BOOKS:

Higher Engineering Mathematics by Dr. M.K. Venkataraman

NM 1102- PHYSICS

Periods/week :4
Sessional. : 30 Exam: 70
Credits: 3

Course Objectives:
- To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.
- To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonics and their applications in engineering.
- To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.
- To Learn basics of lasers and optical fibers and their use in some applications.
- To Understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
- Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.
- Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications.
- Understand the Theory of Superposition of waves. Understand the formation of Newton’s rings and the working of Michelson’s interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit
- Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.
- Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one Dimensional Schrodinger’s wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

SYLLABUS

THERMODYNAMICS
Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot’s Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

ELECTROMAGNETISM
Concept of electric flux, Gauss’s law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart’s Law, B near a long wire, B for a circular Current loop, Ampere’s law, B for a solenoid, Hall effect, Faraday’s law of induction, Lenz’s law, Induced magnetic fields, Displacement current, Maxwell’s equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

Ultrasonics : Introduction, Production of Ultrasonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonics.

OPTICS
**Diffraction:** Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitative treatment).

**Polarisation:** Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

**LASERS and FIBRE OPTICS**
Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers
Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fibre, Numerical aperture, Modes of propagations, classification of fibers, Fibre optics in communications, Application of optical fibers.

**MODERN PHYSICS**
Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi conductors and insulators.

**Nanophase Materials**
Introduction, properties, Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapour deposition method, sol-gel methods, Applications of nano materials.

**TEXT BOOKS:**
2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand

**Reference Books:**
1. Modern Engineering Physics by A.S. Vadudeva
2. University Physics by Young and Freedman
NM 1103- ENGINEERING GRAPHICS

Periods/week :5  Sessional. : 30 Exam: 70  Credits: 3

Course Objectives:
The main objectives of the course are to
CEO1. Understand the basics of Engineering Graphics and BIS conventions.
CEO2. Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings
CEO3. Demonstrate and practice the various profiles/crives used in engineering practice through standard procedures.
CEO4. Demonstrate and practice the orthographic projections of points, lines, planes, solids and section of solids
CEO5. Demonstrate and practice the development of surfaces of simple solids
CEO6. Familiarize the basic concept of isometric views clearly.

Course Outcomes:
After completion of the course, the student will be able to
CO1. Develop simple engineering drawings by considering BIS standards.
CO2. Able to draw different engineering curves with standard Procedures
CO3. Comprehend the basics of orthographic projections and deduce orthographic projections of points, lines, planes and solids at different orientations in real life environment.
CO4. Visualize clearly the sections of solids.
CO5. Apply the concepts of development of surfaces while designing/analyzing any product.
CO6. Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

SYLLABUS

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions, and Scales.
Curves: Conic sections: General construction of ellipse, parabola and hyperbola. Construction of involutes of circle and polygons only. Normal and tangent to curves.

Projections of Points: Principal or Reference Planes, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane.

Projections of Straight Line Inclined to Both the Reference Planes: Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to one reference plane and parallel to other reference plane and parallel to one reference plane and perpendicular to other reference plane and inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to other and axes inclined to both the reference planes.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids (Prism, Pyramid, Cylinder and Cone) in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.
**Isometric Views:** Isometric projection, Isometric scale and Isometric view. Isometric view of Prisms, Pyramids, cylinder, cone, and their combinations.

**Text Book:**

**Reference:**

---

**NM1104 Introduction to Physical Oceanography**

Periods/week : 4  
Sessional. : 30  
Exam: 70  
Credits: 3

**SYLLABUS**

**Physical properties of seawater:** Temperature, Salinity and Density distributions. Transparency of seawater, Sound in the sea, Light in the sea, Colour of seawater, Sea Ice. Measurement of Temperature and salinity With Depth.

**Waves:** wave parameters, deep water waves, shallow water waves, transformation of waves in shallow water, wave generation and dissipation.

Tides: Tide producing forces, Types of tides, tidal theories. major tidal constituents-prediction of tides

**Water masses:** T-S diagram, Characteristics of water masses, Deep circulation water masses, Major water masses of the world oceans.

**Ocean circulation:** Wind induced currents, Upwelling, sinking; equatorial current system, warm and cold currents of major world ocean, seasonal currents in North Indian Ocean, west ward intensification of currents.

Coastal processes: Transformation of waves— refraction, construction of refraction diagram, diffraction, reflection. Coastal and near shore circulation-long shore currents, rip currents and tidal currents.

**Beach features:** Beach cycles, beach profiles—erosion and accretion, Sediment transport rate – onshore and offshore transport – coastal features – LEO observation


Estuaries: Classification, tides in estuaries, estuarine circulation and mixing, Hydrology and hydrograph, sedimentation in estuaries

**Marine geology:** Continental shelf, Slope, Shelf sediments, submarine topography, mid oceanic ridge system, gas hydrates, manganese nodules.

**Marine biology:** Classification of marine environment, Biogeochemical cycles. Influence of Physical parameters (Temperature, salinity, waves, currents, tides etc.). Nitrogen, Phosphorus and Silica controls, Residence time of elements in sea water. Marine Ecosystem: Mangroves, Coral Reefs.

**Text Books:**
1. Introduction to Physical oceanography by M.P.M.Reddy.
2. Introduction to Physical oceanography by Robert.H.Stewart.
3. Introduction to dynamical oceanography by S.Pond and G.L.Pickard.
NM 1105 INTRODUCTION TO NAVAL ARCHITECTURE

Periods/week: 4  Sessional: 30  Exam: 70  Credits: 3

SYLLABUS


Ship terminology and their meaning. Ship lines and procedure to draw them. Introduction to ship construction / production process. Visit to Shipyard.

Economics of waterway transportation.
Domain of Naval Architecture Studies and role of a Naval Architect. Challenges and state of the art.

Avenues for a Naval Architect.

Text Book:
Introduction to Naval Architecture by Eric Tupper- Butterworth Heinemann Publications
**Course Objectives:** The engineering work shop practice is included to introduce some common shop practices and on hands on experience to appreciate the use of skill, tools, equipment and general practices to all the engineering students. This laboratory course is aimed to provide the practical exposure to the students in the fields of Carpentry, Fitting, Sheet Metal and house electrical wiring works to

- Get hands on experience with the working skills in Carpentry trade.
- Know how to work with Sheet Metal tools.
- Get familiar with the working skills of Metal Fitting operations.
- Get hands on experience with house hold electrical wiring.

**Course Outcomes:** By the end of this laboratory, the student

- Can be able to work with Wood Materials in real time applications.
- Can be able to build various parts with Sheet Metal in day-to-day life.
- Can be able to apply Metal Fitting skills in various applications.
- Can be able to apply this knowledge to basic house electrical wiring and repairs.

**Carpentry:** Any three jobs from – Half lap joint, Mortise and Tenon joint, Half – lap Dovetail joint, Corner Dovetail joint, Central Bridle joint.

**Sheet Metal:** Any three jobs from – Square tray, Taper tray(sides), Funnel, Elbow pipe joint.

**Fitting:** Any three jobs from – Square, Hexagon, Rectangular fit, Circular fit and Triangular fit.

**House wiring:** Any three jobs from – Tube light wiring, Ceiling fan wiring, Stair-case wiring, Corridor wiring.

**References:**

*****
NM 1107-PHYSICS LAB

Lab Periods/week : 3  Sessional. : 50  Exam: 50  Credits: 1.5

Course Objectives:
This subject is common to all first year branches of UG engineering. At the end of the course the student is expected to
• To enable the students to acquire skill, technique and utilization of the Instruments
• Draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.
• To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.
• To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge, Spectrometers, travelling microscope, laser device, optical fibre, etc.

Course Outcomes:
• Ability to design and conduct experiments as well as to analyze and interpret
• Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics
• The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

List of Experiments:
1. Determination of Radius of Curvature of a given Convex Lens By forming Newton’s Rings.
3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.
5. Determination of Refractive Index of Ordinary ray $\mu_o$ and Extraordinary $\mu_e$ ray.
10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.
12. Melde’s Apparatus – Frequency of electrically maintained Tuning Fork.
15. Laser- Diffraction.
NM 1108 SHIP WELDING LAB

Lab Periods/week : 3  
Sessional. : 50  
Exam: 50  
Credits: 1.5

LIST OF EXPERIMENTS:
(Practical/hands on)
1. Arc welding of mild steel and stainless steel plates and thermal cycle, cooling rate, macrostructure and Micro structural characterization of welds and Arc welding safety(Lap Joints)
2. Arc welding of mild steel and stainless steel plates and thermal cycle, cooling rate, macrostructure and Micro structural characterization of welds and Arc welding safety(Butt Joints)
3. Arc welding of mild steel and stainless steel plates and thermal cycle, cooling rate, macrostructure and Micro structural characterization of welds and Arc welding safety(T-joint)
4. Arc welding of mild steel and stainless steel plates and thermal cycle, cooling rate, macrostructure and Micro structural characterization of welds and Arc welding safety(Flange Joints)

Study Experiments (Theoretical)
5. Spot welding and Spot Welding safety
6. TIG welding TIG welding safety.
8. Submerged welding and Submerged welding safety.
### B.Tech 1 Year - II Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM1201</td>
<td>BS</td>
<td>Mathematics – II</td>
<td>4 L, 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1202</td>
<td>BS</td>
<td>Chemistry</td>
<td>4 L, 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1203</td>
<td>HSS</td>
<td>English</td>
<td>4 L, 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1204</td>
<td>ES</td>
<td>Computer programming and Numerical Methods</td>
<td>4 L, 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1205</td>
<td>ES</td>
<td>Basic Ship Theory</td>
<td>4 L, 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM1206</td>
<td>HSS</td>
<td>English Language Lab</td>
<td>0 L, 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1207</td>
<td>BS</td>
<td>Chemistry Lab</td>
<td>0 L, 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM1208</td>
<td>ES</td>
<td>Computer programming and Numerical Methods Lab</td>
<td>0 L, 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Total Credits** 19.5
Course Objectives: The contents of this course fulfill the fundamental requirements of knowledge of Mathematics for learning Engineering subjects. The main objectives of student learning are:

- The way of obtaining rank, eigen values and eigen vectors of a matrix.
- To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form.
- To solve the system of equations by using direct and indirect methods.
- To solve first order and higher order differential equations by various methods.
- To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

Course Outcomes: At the end of this course, the student will understand and be able to apply the basic principles of Linear Algebra, ODEs and Laplace Transforms to various engineering problems. Particularly, the student will be able to

- Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.
- Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.
- Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton’s law of cooling
- Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.
- Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

SYLLABUS

Matrix Algebra, Ordinary Differential Equations and Laplace Transforms

(Linear Algebra)

(Eigen Values and Eigen Vectors)
Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton’s theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

(Ordinary Differential Equations of First Order and its Applications)

(Differential Equations of Higher Order)
Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complementary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy’s linear equation - Legendre’s linear equation - Simultaneous linear differential equations.

(Laplace Transforms)

TEXT BOOK:
Scope and Treatment as in “Higher Engineering Mathematics”, by Dr. B.S. Grewal, 43rd edition, Khanna publishers.

REFERENCE BOOKS:
NM 1202 – Chemistry

Periods/week : 4  
Sessional. : 30  
Exam: 70  
Credits: 3

Course Objectives:
- To apply the basic knowledge of Chemistry to the Engineering Discipline.
- To develop knowledge about water and its treatment for industrial and potable purposes.
- To develop understanding in the areas of Polymers, Mechanism of Corrosion of Metals and Corrosion Control Methods, Fuels, Lubricants and Nanomaterials for of conducting polymers, biodegradable polymers and fiber reinforced plastics and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

Course outcome:
- This course applies the basic concepts and principles studied in Chemistry to Engineering.
- It provides an application of chemistry to different branches of engineering.
- The students will be able acquire knowledge in the areas of Water Chemistry, Polymers, Corrosion, Fuels and Lubricants and nanomaterials and suggest innovative solutions for existing challenges in these areas.

SYLLABUS

Water Chemistry

Polymers and Plastics

Corrosion

Fuels and Lubricants
Liquid Fuels: Petroleum Refining – Motor Fuels – Petrol and Diesel Oil – Knocking – Octane number – Cetane Number;  
Gaseous Fuels: Biogas, LPG and CNG – Characteristics – Applications;  
Rocket Fuels: Propellants – Classification – Characteristics  

Nanomaterials
Nanomaterials, Properties and application of fullerenes, fullerols, Carbon nanotubes and nanowires. Synthesis - Top-down and Bottom-up approaches - Nanocomposites - Nanoelectronics- Applications of nanomaterials in catalysis, telecommunication and medicine.

Text Books:
Reference Books:
2. Introduction to Nanoscience - S. M. Lindsay - Oxford University Press

NM 1203 – ENGLISH

Periods/week :4 Sessional: 30 Exam: 70 Credits: 3

Course Objectives:
- To make students understand the explicit and implicit meanings of a text/topic;
- To give exposure to new words and phrases, and aid to use them in different contexts;
- To apply relevant writing formats to draft essays, letters, emails and presentations; and
- To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

Course Outcomes:
- Students will be able to analyse a given text and discover the various aspects related to language and literature;
- Learn the various language structures, parts of speech and figures of speech;
- Develop one’s reading and writing abilities for enhanced communication; and
- Learn to apply the topics in real-life situations for creative and critical use.

SYLLABUS

Reading: On the conduct of life: William Hazlitt
Grammar: Prepositions
Vocabulary: Word Formation I: Introduction to Word Formation
Writing: Clauses and Sentences
Life skills: Values and Ethics
If: Rudyard Kipling

Reading: The Brook: Alfred Tennyson
Grammar: Articles
Vocabulary: Word Formation II: Root Words from other Languages
Writing: Punctuation
Life skills: Self-Improvement
How I Became a Public Speaker: George Bernard Shaw

Reading: The Death Trap: Saki
Grammar: Noun-Pronoun Agreement, Subject- Verb Agreement
Vocabulary: Word Formation III: Prefixes and Suffixes
Writing: Principals of Good Writing
Life skills: Time Management
On saving Time: Seneca

Reading: ChinduYellama
Grammar: Misplaced Modifiers
Vocabulary: Synonyms, Antonyms
Writing: Essay Writing
Life skills: Innovation
Muhammad Yunus
**Reading:** Politics and the English Language: George Orwell

**Grammar:** Clichés, Redundancies

**Vocabulary:** Common Abbreviations

**Writing:** Writing a Summary

**Life skills:** Motivation

*The Dancer with a White Parasol*: Ranjana Dave

---

**Text Book:** Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India. 2018.

**Suggested Readings**

Course Objectives:

- The course is designed to provide complete knowledge of C language.
- To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
- To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.
- This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.
- This course provides the fundamental knowledge which is useful in understanding the other programming languages.

Course Outcomes:

- Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and Apply them in problem solving.
- Apply various operations on derived data types like arrays and strings in problem solving.
- Design and Implement of modular Programming and memory management using Functions, pointers.
- Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.
- Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

1. Introduction to C: Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

2. Decision Making, Branching, Looping, Arrays & Strings: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops ,One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

3. Functions: Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

4. Pointers: Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of points, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications

5. Structure and Unions: Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

6. File handling: Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications

**Text Book:**
2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

**Reference Books:**
3. The C –Programming Language’ B.W. Kernighan, Dennis M. Ritchie, PHI.
SYLLABUS

**Introduction**: Archimedes principle, principles of flotation, types of ships, nomenclature and geometry. Lines plan, and fairing of lines, displacement and tonnage, TPC, coefficients of forms, wetted surface area. Calculation of area, volume, and first and second moments using Simpson’s rule, center of gravity, effect of addition of mass, movement of mass and suspended mass.

**Stability of ships and freeboard**: Transverse stability of ships, statical stability at small angles of heel, calculation of BM, metacentric diagram, free surface effect, Inclining experiment, Bonjean curves, hydrostatic curves. Stability at large angles: Statical Stability Curve, angle of loll, wall sided formula, cross curves of stability, polar diagrams, metacentric evolute, particular cases of righting moment, dynamical stability, stability diagrams, effects of external heeling moments, stability criteria.

**Trim and effects of changes in draught**: Free board, Different types of free board, ships types based on free board, ILLC requirements, freeboard calculations.

**Subdivision of ships**: Causes and types flooding, volume and surface permeability due to bilging of side compartments. Added weight and buoyancy, methods of calculation, subdivision load lines, margin line, floodable length, permissible length, flood able length curves.

**Launching**: Launching arrangement, end launching, side launching, launching calculations, docking and grounding.

**Text Book**: Introduction to Basic Ship Theory- Butterworth Heinemann Publications
NM 1206- ENGLISH LANGUAGE LAB

Lab Periods/week : 3
Sessional. : 50
Exam: 50
Credits: 1.5

Course Objectives:
- To make students recognize the sounds of English through Audio-Visual aids;
- To help students build their confidence and help them to overcome their inhibitions and self-consciousness while speaking in English;
- To familiarize the students with stress and intonation and enable them to speak English effectively; and
- To give learners exposure to and practice in speaking in both formal and informal contexts.

Course Outcomes:
- Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;
- A study of the communicative items in the laboratory will help students become successful in the competitive world;
- Students will be able to participate in group activities like roleplays, group discussions and debates; and
- Students will be able to express themselves fluently and accurately in social as well professional context.

Introduction to Phonetics: The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

Listening Skills: Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

Speaking Skills: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

Reading and Writing skills: Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

Presentation skills: Verbal and non-verbal communication - Body Language - Making a Presentation.

Reference Books:
Course Objectives:
- To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis
- To prepare and use ion exchange/zeolite columns for the removal of hardness of water
- To develop the skill of organic synthesis through the preparation of a polymer/drug

Course Outcomes:
- The course provides quantitative determine the amount of various chemical species in solutions by titrations and conduct the quantitative determinations with accuracy
- The course provides to develop novel materials to be used as zeolite and prepare columns for removal of hardness of water
- The course provides to synthesise a polymer or a drug

List of Experiments
1. Determination of Sodium Hydroxide with HCl (Na₂CO₃ Primary Standard)
2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample
3. Determination of Fe(II)/Mohr’s Salt by Permanganometry
4. Determination of Oxalic Acid by Permanganometry
5. Determination of Chromium (VI) by Mohr’s Salt Solution
6. Determination of Zinc by EDTA method
7. Determination of Hardness of Water sample by EDTA method
8. Determination of Chlorine in water by Iodometric Titration
9. Ionexchange/Zeolite column for removal of hardness of water
10. Synthesis of Polymer/drug

Reference Books:
2. Experiments in Applied Chemistry (For Engineering Students) – Sinita Rattan – S. K. Kataria & Sons, New Delhi
NM1208- NM Computer programming and numerical Methods Lab

Lab Periods/week : 3  Sessional. : 50 Exam: 50  Credits: 1.5

Course Objectives:

- To impart writing skill of C programming to the students and solving problems.
- To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.
- To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.
- This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

Course Outcomes:

- Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.
- Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.
- Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.
- Apply and practice logical ability to solve the real world problems.
- Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?
2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).
3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.
4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?
5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.
6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).
7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.
8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.
9. Implement bisection method to find the square root of a given number to a given accuracy.
10. Implement Newton Raphson method to det. a root of polynomial equation.
11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange’s interpolation/
12. Write a function which will invert a matrix.
13. Implement Simpson’s rule for numerical integration.
14. Write a program to solve a set of linear algebraic equations.
## Course List

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 2101</td>
<td>BS</td>
<td>Mathematics - III</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2102</td>
<td>PC</td>
<td>Engineering Mechanics – I (Statics)</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2103</td>
<td>PC</td>
<td>Mechanics of Materials - I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2104</td>
<td>PC</td>
<td>Basic Thermodynamics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2105</td>
<td>HSS</td>
<td>Managerial Economics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 2106</td>
<td>PC</td>
<td>Computer Aided Ship Design Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2107</td>
<td>PC</td>
<td>Mechanics of Materials Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2108</td>
<td>PC</td>
<td>Ship Drawing - I</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2109</td>
<td>SC</td>
<td>DelftShip Software Practice</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 2110</td>
<td>MC</td>
<td>Professional Ethics &amp; Moral Values</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>NM 2111</td>
<td>MC</td>
<td>NSS/NCC</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Total Credits:** 21.5
CEOS
In general, the students are introduced with a knowledge on the topics: Vector Calculus, Partial differential equations, their applications and Integral Transforms (Fourier transforms, FST, FCT) so as to facilitate them to use these concepts in core subjects.

THE OBJECTIVES, IN PARTICULAR ARE TO LEARN:

- The basic knowledge and applications of Vector Calculus used in Engineering problems.
- About the gradient, divergence and curl under the differentiation of scalar and vector point functions, also on Line-, Surface- and Volume integrals under the integration of point functions along with their applications in Engineering issues.
- Transformation theorems such as Green's theorem in the plane, Stoke’s theorem, Gauss Divergence theorem and their applications.
- How to formulate the Partial Differential Equations from the relation between the dependent and independent variables, the methods of solving first order first degree linear, non-linear Partial Differential Equations, Homogeneous and Non homogeneous linear partial differential equations with constant coefficients.
- The procedure to find out the solutions of Partial Differential Equations by using the method of separation of variables (product method) about the formulation of one dimensional wave (string equation), one-and two-dimensional Heat flow equations, Laplace’s equation in Cartesian and polar coordinates, and how to solve these equations using the method of separation of variables.
- The concept of integral transforms, namely, Fourier transforms, Fourier Sine, Cosine and related inverse transforms, and their applications in solving several Physical and Engineering problems.

COS
- After going through this course, the students would be able to:
  - Operate the differential operator 'del' to the scalar and vector point functions, Calculate the Gradient, Divergence and Curl, Vector normal to a surface, maximum rate of change of a scalar field, test whether two surfaces are to cut orthogonally or not.
  - find the rate per unit volume at which the physical quantity is issuing from a point, the rate of inflow minus out flow using the Divergence and the angular velocity of rotation at any point of the vector field using the Curl.
  - Test whether the given motion is irrotational or rotational, whether a vector force acting on a particle is conservative or not.
  - find out the potential function from a given vector field.
  - obtain the well known Laplace and poisson equations from an irrotational field.
  - understand to determine the work done by a force field and circulation using a Line integral.
  - find out the Line, Surface and Volume integrals, find flux using surface integral and volumes using the volume integral.
• apply the vector integral theorems (Green’s theorem in the plane, Stoke’s and Divergence theorems) for evaluating the double and triple integrals as these are used to find areas and volumes.
• know the methods of solving Linear and Non linear first order and first degree partial differential equations.
• solve the Linear Partial Differential Equations with constant coefficients (homogeneous and non homogeneous) and know the procedure for finding the complementary function and particular integrals
• apply the method of separation of variables to obtain solutions to the boundary value problems involving Linear partial differential equations occurred in engineering studies
• solve wave equation, heat flow equation and the Laplace’s equations in Cartesian and polar coordinates using the method of separation of variables.
• apply and extend the knowledge of Fourier transform techniques in solving several Initial and Boundary value problems of Engineering, such as in Conduction of heat / Thermodynamics, Hydraulics transverse vibrations of a string, oscillations of an elastic beam, bending of beams, electrical circuits, free and forced vibrations of a membrane and transmission lines, etc.

SYLLABUS

VECTOR CALCULUS - DIFFERENTIATION
Differentiation of vectors, curves in space, velocity and acceleration, relative velocity and relative acceleration, scalar and vector point functions, vector operator \( \nabla \) applied to scalar point functions- gradient, \( \nabla \) applied to vector point functions- divergence and curl. Physical interpretation of gradient, divergence and curl (i.e., \( \nabla f, \nabla \vec{F}, \nabla \times \vec{F} \)), Irrotational and Solenoidal fields, the relations obtained after \( \nabla \) applied twice to point functions, \( \nabla \) applied to products of two functions.

LO-1:
To obtained knowledge on Differentiation of vectors and also to solved problems on vector Calculus

VECTOR INTEGRATION
Integration of vectors, line integral, circulation, work done, surface integral-flux, Green’s theorem in the plane, Stoke’s theorem, volume integral, Gauss Divergence theorem. (All theorems without proofs)
Introduction of orthogonal curvilinear coordinates, cylindrical and spherical polar coordinates

LO-2:
To find out the as many as coordinates and the application of various theorems.

PARTIAL DIFFERENTIAL EQUATIONS

LO-3:
To solve linear equations of first order and also o solve non-homogenous linear equations.

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Method of separation of variables, One dimensional wave equation-vibrations of a stretched string, one dimensional Heat flow equation, Two dimensional heat flow in steady state - solution of Laplace’s equation in Cartesian and polar coordinates (two dimensional).
LO-4: To find the various applications of partial differential equations in two dimensional heat flow in steady state.

**INTEGRAL TRANSFORMS (Fourier Transform)**
Convolution theorem for Fourier transforms, Parseval’s identity for Fourier transforms, Fourier transforms of the derivatives of a function, simple applications to Boundary value problems.
LO-5 To obtained knowledge on Fourier series and on Fourier transforms.

**TEXT BOOKS:**

**REFERENCE BOOKS:**
NM 2102 ENGINEERING MECHANICS-I (STATICS)

Periods/week : 4  Sessional. : 30  Exam: 70  Credits: 3

Course Educational Objectives

- The objectives of the course are
- To teach the student how to determine the resultant force and moment for a given force system.
- To Teach the student how to Analyze planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction.
- To Teach the student how to determine the centroid and second moment of area
- To Teach the student the method of Virtual Work for the solution of Engg Mechanic problems

Course outcomes:

- At the end of the course, the student will be able to:
- Determine the resultant force and moment for a given force system.
- Analyze planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction.
- Determine the centroid and second moment of area
- Learn the method of Virtual Work for the solution of Engg Mechanic problems

SYLLABUS

General Principles : Fundamental concepts, Units of Measurement, SI Units

LO-1:

- To provide an introduction to the basic quantities and idealizations of mechanics.
- To give a statement of Newton’s Laws of Motion and Gravitation.
- To present a general guide for solving problems.

Force Vectors. Vector Operations, vector addition of forces, Coplanar forces, Cartesian vectors, Position vectors, Force vector directed along a line, dot product
LO-2:
- To show how to add forces and resolve them into components using the Parallelogram Law.
- To express force and position in Cartesian vector form and explain
- To introduce the dot product in order to determine the angle between two vectors or the projection of one vector onto another

Equilibrium of a Particle Condition for the equilibrium of a particle, coplanar force system, Three-dimensional force systems

LO-3
- To introduce the concept of the free-body diagram for a particle.
- To show how to solve particle equilibrium problems using the equations of equilibrium.

Force System Resultants Moment of a force, scalar and vector formulation, principle of moments, moment of a force about a specified axis, moment of a couple, equivalent system, resultants of a force and couple system, further reduction of force and couple systems, distributed loading

LO-4:
- To provide a method for finding the moment of a force about a specified axis.
- To define the moment of a couple.

Equilibrium of a Rigid Body Conditions for equilibrium of a rigid body, free body diagrams, equations of equilibrium, two and three force members, equilibrium in 3-D, constraints for a rigid body

LO-6:
- To introduce the concept of the Equilibrium of a Rigid body.
- To show how to solve Rigid body equilibrium problems using the equations of equilibrium.

Structural Analysis Simple Trusses, method of joints, zero force members, method of sections, space trusses, frames and machines

LO-7:
- To solve problems on Simple Trusses
- To show how to solve problems on Frames and machines

Friction Characteristics of dry friction, problems involving dry friction, wedges, screws, flat belts

LO-8
- To introduce the concept of friction and to solve problems in dry friction.

Center of Gravity and Centroid Centre of gravity, centre of mass, centroid, composite bodies, pappus Guldinus theorem, distributed loading resultants.

LO-9:
- To introduce the concept of Centroid, Center of gravity and center of mass.

Moments of Inertia MI, parallel axis theorem, MI of area by integration, MI of composite areas, product of inertia, Mass MI

LO-10:
- To Derive MI of various composite areas and composite bodies.

Virtual Work Principle of VW for particle and rigid body, and system of connected bodies, conservative forces, PE, PE criterion for equilibrium, stability of equilibrium

LO-11
- To introduce the concept of Principal of Virtual Work

Text Book:

References:


Course Objectives:
- To provide the student with an understanding of Stress and Strain, thermal stresses, Mohr’s circle for the solution of stress in 2-D
- To teach the student regarding the structural elements like trusses and frames and their analyses
- Teach the student to Draw the BM and SFD
- To determine the deflection in beams subjected to various loadings
- To understand the concept of Torsion and evaluate the stresses in shafts and springs

Course Outcomes
- At the end of the course the student will be able to
- Calculate the state of stress including thermal stresses.
- Design structural elements like trusses and frames and beams
- Determine the state of stress in beams and the deflection of beams.
- Design shafts and springs

SYLLABUS


LO-1:
Understand the fundamental concepts of stress and strain and the relationship between both through the strain-stress equations in order to solve problems for simple tridimensional elastic solids

Bending moments and shear forces: Types of beams, Types of loads, Types of supports. S.F. and B.M. diagrams for statically determinate beams. Relation between bending moment, shear stress and intensity of loading.

Lo-2:
Calculate and represent the stress diagrams in bars and simple structures

Stresses in beams: Simple theory of bending, Flexural formula, Shear stress in beams. Principal stresses in beams.
Deflection of beams: Relation between curvature, slope and deflection. Double integration method.

Torsional stresses in shafts: Analysis of torsional stresses, power transmitted by circular shafts. Combined bending and torsion. Principal stresses in shafts.

LO-3:
Solve problems relating to pure and non-uniform bending of beams and other simple structures

Closed and opened coiled helical springs: Analysis of principal stresses in open and closed coiled helical springs.

Thin walled cylindrical and spherical vessels: Analysis of stresses and strains.

LO-4:
Understand the concept of buckling and be able to solve the problems related to isolated bars

Text Books:
Engineering mechanics of solids by E.P.Popov, second edition, PHI.
References:

NM 2104  BASIC THERMODYNAMICS

Course Objectives:
. The objectives of the course is to teach the student Fundamental concepts of continuum, system, control volume, thermodynamic properties, thermodynamic equilibrium, work and heat.
. The various laws of thermodynamics so that he can analyze systems like boilers, heat pumps, refrigerators, heat engines, compressors and nozzles.
Evaluate the performance of vapour power cycles.

Course Outcomes:
At the end of the course, the student will be able to:
. Understand the concepts of continuum, system, control volume, thermodynamic properties, thermodynamic equilibrium, work and heat.
. Apply the laws of thermodynamics to analyze boilers, heat pumps, refrigerators, heat engines, compressors and nozzles.
. Evaluate the performance of vapor power cycles.

SYLLABUS
LO-1:
To explain fundamental thermodynamic properties

Thermodynamic Laws: Zeroth law _First law - Corollaries- Isolated systems and steady flow systems- Specific heats - First law applied to flow systems- Systems undergoing a cycle and change of state- First law applied to steady flow processes- Limitations of first law of thermodynamics.
LO-2:
Derive and discuss the first and second laws of thermodynamics

Second law- Kelvin Plank statement and Classius statement and their equivalence, Corollaries- PMM 1 & PMM 2 - Reversibility and irreversibility- Causes of irreversibility- Carnot cycle- Heat engines and heat pumps- Carnot efficiency- Classius theorem- Classius inequality- Concept of entropy
LO-3:
Analyse basic thermodynamic cycles.


LO-4:
To improve the knowledge on various power cycle.

**Steam Nozzles:** Type of nozzles- Flow through nozzles- Condition for maximum discharge- Nozzle efficiency- Super saturated flow in nozzles- Steam injectors.

**Steam Turbines:** Classification of steam turbines- Impulse turbine and reaction turbine- Compounding in turbines- Velocity diagrams in impulse and reaction turbines- Degree of reaction- Condition for maximum efficiency of reaction turbines

**Condensers:** Classification of condensers - Sources of air leakage in condensers- Condenser efficiency

LO-5:
To Explain velocity diagrams in turbines.

**Text Books:**
2. Thermodynamics (SI Version) by William Z Black & James G Hartley

**References:**
3. Fundamentals of Engineering Thermodynamics By E Radhakrishnan
NM 2105 MANAGERIAL ECONOMICS

Periods/week : 4  
Sessional: 30  
Exam: 70  
Credits: 3

Course Objectives:
- To bring about an awareness about the nature of Managerial Economics and its linkages with other disciplines.
- To understand the Micro and Macro Environment of Business.
- To familiarize the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

Course Outcomes:
- After completion of the course, student will be able to:
- Understand the various economic activities in business and industry.
- Analyse the real world business problems.
- Make optimal business decisions for the effective and efficient management of Organisations.

SYLLABUS

Significance of Economics and Managerial Economics:


LO-1:
To know the basic fundamentals of Economics

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

LO-2:
To know about Managerial Economics

Demand and Utility Analysis:

Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

LO-3:
To understand the concept of Demand

Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

LO-4:
To obtained the knowledge on Elasticity of demand


LO-5 :
To know the concept of Utility Analysis
Theory of Production and Cost analysis:
Production - Meaning, Production function and its assumptions, use of production function in decision making;

Cost analysis - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. Unavoidable costs, Economies and Diseconomies of scale.

LO-6:
To know the Theory of Production and Cost analysis.

Market Structures : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition.

Pricing and Business Cycles:
Pricing Analysis : Pricing – Significance; Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark- down pricing of retailers.

LO-7:
To know the concept of Pricing and Business Cycles.

Business cycles - Definition, Characteristics, Phases, Causes and Consequences; Measures to solve problems arising from Business cycles.

Text Books:

Reference Books:
NM 2106 COMPUTER AIDED SHIP DESIGN LAB

Lab Periods/week : 3  Sessional. : 50  Exam: 50  Credits: 1.5

Course Objectives
- The objectives of the course are to provide training and provide hands on experience to the students on CAD software

Course Outcomes
- At the end of the course, the student will be in a position to model a ship using the software

Syllabus

CASD experiments:
1. Initiating the graphics package; Setting the paper size, space; setting the limits, units; use of snap and grid commands.
2. Drawing of primitives (line, arc, circle, ellipse, triangle etc.)
3. Drawing a flange.
4. Drawing a Bushing assembly.
5. Dimensioning the drawing and adding text.
6. Setting the layers and application of the layers.
7. Isometric and orthographic projections.
8. Viewing in Three dimensions.
9. Removal of hidden lines - Shading and rendering
NM 2107 – MECHANICS OF MATERIALS LAB

Periods/week : 3  Ses. : 50  Exam : 50
Examination Practical: 3hrs.  Credits: 1.5

List of Experiments:
1. To study the stress strain characteristics (tension and compression) of metals by using UTM.
2. To study the stress strain characteristics of metals by using Hounsefield Tensometer.
3. Determination of compression strength of wood.
4. Determination of hardness using different hardness testing machines- Brinnels, Vickers and Rockwell's.
5. Impact test by using Izod and Charpy methods.
6. Deflection test on beams using UTM.
7. Tension shear test on M.S. Rods.
8. To find stiffness and modulus of rigidity by conducting compression tests on springs.
9. Torsion tests on circular shafts.
11. Punch shear test, hardness test and compression test by using Hounsefield tensometer.
12. Sieve Analysis and determination of fineness number.

NM 2108 SHIP DRAWING – I

Lab Periods/week : 3  Sessional. : 50 Exam: 50  Credits: 1.5

Theory
Lines plan: Drawing instruments and other equipment uses. Delineation of lines plan, Drawing of lines plan, Drawing of ship lines from basic Naval Arch Principles. Drawing of ship lines using series data. Special features and characteristics of ship lines. Mathematical representation of ship lines. Computer aided drawing and design. Use of scales and fairing of ship lines. Capacity calculations, capacity plan, scales, Bonjean curves, sectional area curves and their properties.

**Practical:**
Lines plan, capacity plan, Bonjean curves, sectional area curves, special features of ship drawing tables, paper, area curves, tracing paper, pencil drawing and ink tracing techniques. Drawing of curved lines with battens, types of battens. Dos and Don’ts while using battens. Use of French curves and paper strips for fairing lines.

---

**NM 2109 DELFTSHIP SOFTWARE PRACTICE**

Lab Periods/week : 3 
Sessional. : 50 Exam: 50 
Credits: 2

**Course Objectives**
- The objectives of the course are to provide training and provide hands on experience to the students on Delftship software for the purpose of hydrostatic calculations and resistance calculations

**Course Outcomes**
- At the end of the course, the student will be in a position to model a ship using the software
- perform a detailed hydrostatic calculation
- Obtain the ship resistance

**Detailed Syllabus**
Delftship Main window features, Project Settings, Hull Modelling, Hydrostatic Calculations, Design Hydrostatics, Hydrostatics, Resistance, Report writing and explanation
NM2110 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Course Objectives:
- The objective of the course is Six fold:
- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- This course will illuminate the students in the concepts of laws and its applicability to engineers.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection, Development of commitment and courage to act and also enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and professional lives.
- To enable the students to imbibe the Values and Ethical Behavior in the personal and Professional lives.
- The students will learn the rights and responsibilities Individual, employee, team member and a global citizen.

Course Outcomes:
- By the end of the course Student will be able to:
- Grasp the meaning of the concept – Law and also Get an overview of the laws relating to Engineers and also Apprehend the importance of being a law abiding person and They would have better critical ability.
- Self-explore by using different techniques to live in harmony at various levels.
- Analyze themselves and understand their position with respect to the moral and ethical character needed for a successful and satisfactory work life.
- Students are expected to become more aware of themselves and their surroundings (family, society, nature).
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

SYLLABUS

Need, Basic Guidelines, Content and Process for Value Education
Self-Exploration—what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation - as the process for self-exploration, Continuous Happiness and Prosperity - A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking. Include practice sessions and case studies.

LO-1: To know about Need, Basic Guidelines, Content and Process for Value Education

Understanding Harmony in the Human Being - Harmony in Myself!
Understanding human being as: a co-existence of the sentient ‘I’ and the material ‘Body’, the needs of Self (‘I’) and ‘Body’ - happiness and physical facility, the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer), the characteristics and activities of ‘I’ and harmony in ‘I’, the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, ensure Sanyam and Health, Include practice sessions and case studies.

LO-2: To provide knowledge on Understanding Harmony in the Human Being

Understanding Harmony in the Family and Society - Harmony in Human – Human Relationship
Understanding values in human-human relationship: meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, the meaning of Trust; Difference between intention and competence, the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, the harmony in the society (society being an extension of family), Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order from family to world family, Include practice sessions and case studies.

LO-3: To Understanding Harmony in the Family and Society, Harmony in Human and Human Relationship

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence
Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all – pervasive space, Holistic perception of harmony at all levels of existence, Include practice sessions and case studies.

LO-4: To Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Concept of Law and Law of Torts

LO-5: To know the Concept of Law and Law of Torts

Implications of the above Holistic Understanding of Harmony on Professional Ethics
Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and
develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Include practice sessions and case studies.

LO-6: To Provide basic Implications of the above Holistic Understanding of Harmony on Professional Ethics

Text Books

Reference Books

NM 2111 NSS/NCC
# B. Tech - II Year - II Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 2201</td>
<td>ES</td>
<td>Electrical Technology</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2202</td>
<td>BS/P</td>
<td>Eng. Mechanics – II (Dynamics)</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2203</td>
<td>PC</td>
<td>Mechanics of Materials - II</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2204</td>
<td>PC</td>
<td>Engineering Therodynamics</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2205</td>
<td>PC</td>
<td>Material Science</td>
<td>4 L 0 P</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 2206</td>
<td>PC</td>
<td>Electrical Tech Lab</td>
<td>0 L 3 P</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
</tbody>
</table>
NM 2201 ELECTRICAL TECHNOLOGY

Periods/week : 4  Sessional. : 30  Exam: 70  Credits: 3

Course Objectives:
- Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
- Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
- To explain the working principle, construction, applications of DC machines, AC machines & measuring instruments.
- Highlight the importance of transformers in transmission and distribution of electric power.

Course Outcomes:
- On completion of the course students will be able to
- Predict the behavior of electrical and magnetic circuits.
- Formulate and solve complex AC, Dc circuits.
- Identify the type of electrical machine used for that particular application.
- Realize the requirement of transformers in transmission and distribution of electric power and other applications.
SYLLABUS

Magnetic Circuits: Definitions of magnetic circuit, Reluctance, Magneto motive force (m.m.f.), Magnetic flux, Simple problems on magnetic circuits, Hysteresis loss. (Chapter-8, Pages 155-175).

LO-1: Understand the fundamentals of e.m.f, potential difference, current, resistance and energy conversions from one form to another


LO-2: Understand the basics of magnetic circuits and Identify the relationship between current and magnetic fields with application to determination of inductance


LO-3: Apply the concept of electromagnetism to understand Generator operation and interpret the relationship between charge and electric fields with its application.


LO-4: Analyze D. C. circuits, interpret relationship between voltage, current and power, examine concept of resonance, and analyze balanced three phase circuits.


LO-5: Apply the concept of electromagnetism to understand Transformer operation and interpret the relationship between charge and electric fields with its application


LO-6: Analyze and solve D. C. networks by applying various laws and theorems.


Electrical Measurements: Principles of measurement of current, voltage, power and energy, Types of Ammeters, Voltmeters, Watt-meters, Energy meters, Electrical conductivity meter, Potentiometer, Megger.

LO-7: Solve problems on principles of measurement.
Text Book:
Elements of Electrical Engineering and Electronics by V.K. Mehta, S. Chand & Co.

Reference:
First Course in Electrical Engineering by Kothari.

NM 2202 ENGINEERING MECHANICS – II (DYNAMICS)

Periods/week : 4  Sessional. : 30  Exam: 70  Credits: 3

Course Objectives:
The objectives of the course are

. To introduce the concepts of position, displacement, velocity, and acceleration
. To analyze the accelerated motion of a particle using the equation of motion with different coordinate systems.
. To develop the principle of work and energy
. To study the conservation of linear momentum for particles.
. To introduce the concept of angular impulse and momentum.
. To discuss applications of these equations to bodies undergoing translation, rotation about a fixed axis, and general plane motion.
. To show how the conservation of energy can be used to solve rigid–body planar kinetic problems.
To apply the principles of linear and angular impulse and momentum to solve rigid-body planar kinetic problems that involve force, velocity, and time.

**Course Outcomes**

At the end of the course the student will be in a position to

1. Understand the concepts of position, displacement, velocity, and acceleration
2. Analyze the accelerated motion of a particle
3. Solve problems in kinetics using Newton's Second law as well as principle of work and energy and conservation of linear momentum and angular momentum for particles
4. Write the equations on motion for a plane body in translation, rotation about a fixed axis, and general plane motion.
5. Use various techniques to solve kinetic problems in Plane motion.

**SYLLABUS**

**Kinematics of a Particle**


LO-1: Ability to form the relation between displacement, velocity and acceleration

**Kinetics of a Particle: Force and Acceleration**


LO-2: Ability to form the equilibrium equations under dynamic forces, to calculate the unknowns of the equations, to determine the motion of the body

**Kinetics of a Particle: Work and Energy**


**Kinetics of a Particle: Impulse and Momentum**


LO-3: To know the knowledge of Impulse and Momentum

**Planar Kinematics of a Rigid Body**


LO-4: To provide the basic knowledge on Instantaneous center.

**Planar Kinetics of a Rigid Body: Force and Acceleration**


**Planar Kinetics of a Rigid Body: Work and Energy**
LO-5: To Solve problems on principle of work and energy

Planar Kinetics of a Rigid Body: Impulse and Momentum
Lo-6: To provide the knowledge on kinetics of a rigid Body.

Text Book:

References:

NM 2203 MECHANICS OF MATERIALS – II
Periods/week : 4 Sessional. : 30 Exam: 70 Credits: 3
Course objectives:

- To provide basic knowledge in mechanics of materials so that the students can solve real engineering problems and design engineering systems.
- Analyze and design components and structural members subjected to tension, compression, torsion, bending and combined loads using fundamental concepts of stress, strain, elastic and inelastic behavior.

Course Outcomes:

- Understand the fundamental concepts of stress and strain and the relationship between both through the strain-stress equations in order to solve problems for simple tridimensional elastic solids.
- Calculate and represent the stress diagrams in bars and simple structures Solve problems relating to pure and non-uniform bending of beams and other simple structures.
- Solve problems relating to torsional deformation of bars and other simple tri-dimensional structures.
- Understand the concept of buckling and be able to solve the problems related to isolated bars.

SYLLABUS

Statically indeterminate Beams:

Fixed Beams: Fixing moments of a fixed beam of uniform cross section. Effect of sinking of supports, Slope and deflection.
Continuous beams: Analysis of continuous beams, Reaction at the supports, Effect of sinking of supports. B.M. and S.F. diagrams.
LO-I: To solve problems on Fixed beams and Continuous Beams and Analyze a statically indeterminate structure.

Columns and struts

LO-2: To calculate Euler’s formulae for the end conditions of the column

Bending of curved bars

Stresses due to bending of curved bars of circular, rectangular and trapezoidal sections, curved bars subjected to eccentric loads such as crane hook.
LO-3: To Analysis the stresses due to curved bars of various geometric sections.

Thick cylinders

Subjected to internal and external pressure cylinders.
Theories of failure: Application to design of shafts.
LO-4: To Calculate Pressure in cylinders.

Text Books:
1. Engineering mechanics of solids by E.P.Popov,second edition .PHI.
3. Strength of materials by L.B.Shah and DrR.T.Shah

NM 2204 ENGINEERING THERMODYNAMICS

Periods/week: 4  Sessional: 30  Exam: 70  Credits: 3
Course objectives:

- To develop the student’s ability to apply the principles of thermodynamics to the optimal design of the basic energy conversion systems: power generation, refrigeration, air-conditioning, and combustion.

- To develop the student’s ability to use thermodynamic relations and the property tables and charts for the analysis of energy conversion systems in the course of their operation.

- To provide the students with some knowledge and analysis skills associated with the principles and techniques of the design of energy conversion systems.

- To develop the student’s ability to communicate effectively the knowledge of thermodynamics and energy conversion systems.

Course Outcomes

- Students will demonstrate an ability to apply thermodynamic principles to the design, analysis, and optimization of the basic energy conversion systems: power generation, refrigeration, air-conditioning, and combustion.

- Students will demonstrate an ability to use thermodynamic relations and the physical property tables and charts for the analysis of gas and vapor power mixtures, phase transformations, chemical reactions, and combustion processes.

- Students will demonstrate an ability to apply the first and the second laws of thermodynamics to the analysis and optimization of the power generation, refrigeration, air-conditioning, combustion, and gas flow processes.

- Students will demonstrate an ability to determine engineering design quantities and estimate their effects on the basic performance characteristics of the energy conversion systems.

- Students will demonstrate an ability to communicate effectively the knowledge of thermodynamic principles, energy balance equations, and the use of the physical property tables and charts for the analysis of the energy conversion systems.

SYLLABUS


LO-1: To Understand the various engine components

**Combustion in I.C. Engines:** S.I. engines- Normal combustion and abnormal combustion- Importance of flame speed and effect of engine variables, types of abnormal combustion pre-ignition and knock, Fuel requirements and fuel rating, anti-knock additions- Combustion chamber requirements and Types of combustion chamber

LO-2: To demonstrate an ability to use thermodynamic relations and the physical property tables and charts for the analysis of gas and vapor power mixtures, phase transformations, chemical reactions, and combustion processes

**Reciprocating and Rotary Compressors:** Reciprocating compressors, effect of clearance volume in compressors, volumetric efficiency, single stage and multi stage compressors, effect of inter cooling in multi stage compressors. Centrifugal compressor- Adiabatic efficiency- Diffuser- Axial flow compressors

LO-3: To Understand the fuel supply and the ignition systems.

LO-4: Understand the turbo charging, supercharging and new engine technology

**Refrigeration & Air Conditioning:** Bell Colemen cycle, Vapor compression cycle. Vapor absorption system, Principles of psychrometry – psychometric Chart and terminology, air conditioning systems.

LO-5: To provide basic knowledge on Refrigeration and Air Conditioning.

**Text Books:**

**References:**
1. I.C. Engines by V. Ganesan.
Course Objectives:
- To describe the basics of crystal structure and its types
- To gain a thorough knowledge about crystal defects
- To gain a knowledge about electrical and electronic properties of materials
- To gain knowledge of magnetic and optical properties of materials

Course Outcomes:
At the end of the course Student would be able
- To use and apply basics of material science in his own branch of engineering.
- The student will be able to justify the materials behaviour and their properties
- To get basic foundation for learning material technology
- Understand the advances in the materials development.

SYLLABUS
Lo-1: To describe basic definition and conception of materials and physical properties of materials.

Lo-2: Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF

LO-3: To give information about phase diagrams.


LO-4: To provide fundamental knowledge on powder metallurgy and composite materials.

Text Books:
1. Materials Science and Engineering, by V.Raghavan.

References:

NM 2206 – ELECTRICAL TECHNOLOGY LAB

Lab Periods/week : 3 Sessional. : 50 Exam: 50 Credits: 1.5

List of Experiments:

1. Study and Calibration of wattmeter and energy meter.
3. Verification of KCL and KVL.
4. Superposition theorem.
5. Parameters of a choke coil.
6. OC and SC tests on transformer.
7. Load test on D.C. shunt machine.
8. O.C. test on D.C. separately excited machine.
10. 3 phase induction motor (No load and rotor block tests) load tests. Alternator regulation by Syn. Impedance method.
List of Experiments:

1. Getting Started with AutoCAD Opening and Creating Drawings Exploring the AutoCAD interface Zooming and Panning

2. Basic Drawing & Editing Commands Using the Mouse, Keyboard, and Enter Key to work quickly and efficiently in AutoCAD Lines Circles Rectangles

3. Projects - Creating a Simple Drawing Creating Simple Drawings Using Object Snap

4. Tracking to extrapolate a projected top view Using Modify tools to arrange an office layout

5. Drawing Precision in AutoCAD Polar and Ortho Tracking Entering Coordinates and Angles Object Snaps and Tracking

6. Making Changes in Your Drawing Move Copy Rotate Mirror Scale Using the reference option with the Scale Tool

7. Drawing Templates Using Template Files (.dwt) to Make New Drawing Exploring what Settings and Elements are saved with Templates


9. Advanced Object Types Polylines Arcs Polygons Ellipses

10. Analyzing Model and Object Properties The Properties Palette Quick Select Similar Measure Geometry Tools

11. Advanced Editing Commands Trim and Extend Fillet and Chamfer Polyline Edit and Spline Offset and Explode Join

12. Inserting Blocks The Insert Block Command Inserting Blocks with Tool Palettes Dynamic Blocks Migrating Blocks and other Elements between Drawings with Design Center

13. Projects - Creating More Complex Objects
NM 2208 INTELLECTUAL PROPERTY RIGHTS SKILL DEVELOPMENT COURSE

Lab Periods/week : 3  Sessional : 50  Exam: 50  Credits: 2

Course Objectives:
- To introduce the students to Intellectual Property Rights (IPR) which is a key component in modern knowledge management processes
- To create consciousness on IPR in students at an early stage of their education so that they develop an appreciation for ethical and rightful use of existing knowledge
- To make them understand how to take ownership of knowledge they may develop as a result of their creative innovations, take ownership and either drive themselves in becoming entrepreneurs or become responsible knowledge users in society
- To expose students some of the recent debates on the societal implications of IPR and its role in national/international trade and socio-economic development.

Course outcome:
Learners will be able to
- Identify the types of intellectual property protection available for their research outcome
- conduct patent search and analyze patentability of the invention
- understand the basic structure of Patent document
- understand the registration and prosecution of different IPs
- understand the basics of IP commercialization and techno/commercial/legal issues in IPR commercialization

SYLLABUS

Introduction
Concept of property, Intellectual Property (IP) and Intellectual Property Rights (IPR), Importance of IP, Value creation through IP, Advantages of IP protection, Competitive advantage, Promotion of social good, Prevention of duplicates, counterfeit products and IP
LO-I: To Illustrate research problem formulation

Evolution of IP system
Historical view of IP system in India and abroad, Legal basis and rationale behind development of IP system, WTO and TRIPS agreement, Role of WIPO
LO-2: Summarize the approaches of investigation of solutions for a research problem

Types of IPR
Major forms of IP in India and globally, Acts enacted in India related to IP
LO-3: Discover the new developments in IPR

Patent
Concept, Life of patent, Rights of Patentee, Criteria of patentability- novelty, non-obviousness, and utility, Non-patentable inventions
LO-4: Outline the process of patenting and development

Patent filing and prosecution
Prior art search, Process of obtaining a patent in India, Provisional and complete specification, Convention application, Patent Cooperation Treaty (PCT), Patent Infringement and Enforcement
LO-5: Explain patent right and its scope

**Trademark**
Types of trademarks, Trademark and Brand, Trademark Registration, Trademark Infringement

**Copyright**
Copyrights and related rights, Copyright registration, Copyright infringement, Section 52 of Indian Copyright Act

**Industrial Design**
What is Industrial design, Design registration, Design infringement

**Trade Secret**
What are Trade Secrets, How trade secrets are maintained in trade and business

LO-6: Make use of Patent information and databases

**Other forms of IP**
Semiconductor Integrated Circuits Layout Design, Geographical Indications, Protection of Plant Varieties & Farmers’ right, Traditional knowledge

LO-7: Discover the new developments in IPR

**IP commercialization**
Licensing & Royalty; Technology Transfer; IP assignment, Compulsory License

**Emerging areas**
Patinformatics, IP and bank loan, IP insurance, IP audit, IP valuation, IP management, Use of artificial intelligence in IP enforcement, Open innovation

LO-8: Explain the procedure for granting patent

**Text Books**

**Reference Books**
4. The Indian Patents Act 1970 (as amended in 2005)
5. The Indian Copyright Act 1950 as amended in 2017)
6. Indian Trademarks Act 1999
7. The Indian Industrial Designs Act 2000
8. The Protection of Plant Varieties and Farmers' Right Act 2001
9. Inventing the Future: An Introduction to Patents for small and medium sized enterprises, WIPO publication No 917 www.wipo.int/ebookshop
10. Looking Good: An Introduction to Industrial Designs for Small and Medium sized Enterprises; WIPO publication No.498 www.wipo.int/ebookshop
Course Objectives
The objectives of the Environmental Science course are to

- Familiarize the fundamental aspects of environment and the environmental management’
- Provide information of some of the important international conventions which will be useful during the future endeavors after graduation.
- Make realize the importance of natural resources management for the sustenance of the life and the society.
- Apprise the impact of pollution getting generated through the anthropogenic activities on the environment
- Provide the concept of Sustainable Development, energy and environmental management
- Impart knowledge on the new generation waste like e-waste and plastic waste.

Course Outcomes
After completion of the course the students will have

- Knowledge on the fundamental aspects of environment and the environmental management
- The knowledge on the salient features of the important international conventions
- Understanding of the importance of natural resources management for the sustenance of the life and the society.
- Familiarity on various forms of pollution and its impact on the environment.
- Understand the elements of Sustainable Development, energy and environmental management
- Knowledge on the new generation waste like e-waste and plastic waste.

SYLLABUS

LO-I: Articulate the interconnected and interdisciplinary nature of environmental studies;

Natural Resources Management: Importance of natural resources management-Land as resource, Land degradation, Soil erosion and desertification, Effects of usage of fertilizer, herbicides and pesticide- watershed management.
LO-2: Demonstrate an integrative approach to environmental issues with a focus on sustainability
**Forest resources:** Use and over-exploitation, Mining and dams – their effects on forest ecosystems and the living beings.

**Water resources:** Exploitation of surface and groundwater, Floods, droughts, Dams: benefits and costs.

**Mineral Resources:** Impact of mining on the environment and possible environmental management options in mining and processing of the minerals.  
Sustainable resource management (land, water, and energy), and resilient design under the changing environment.  
LO-3: Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.

**Environmental Pollution:** Local and Global Issues. Causes, effects and control measures. Engineering aspects of environmental pollution control systems.


LO-4: Appreciate that one can apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.

**Sustainable Development:** Fundamentals of Sustainable Development – Sustainability Strategies and Barriers – Industrialization and sustainable development. Circular economy concepts in waste (solid and fluid) management.

**Energy and Environment:** Environmental Benefits and challenges, Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Solar Energy: process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and applications, disposal of solar panel after their usage. Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in context of India.  
LO-5: Understand and evaluate the global scale of environmental problems

**Management of plastic waste and E-waste:** Sources, generation and characteristics of various e- and plastic wastes generated from various industrial and commercial activities; Waste management practices including onsite handling, storage, collection and transfer. E-waste and plastic waste processing alternatives. E-Waste management rules and Plastic waste management rules, 2016 and their subsequent amendments.  
LO-6: communicate clearly and competently matters of environmental concern and understanding to a variety of audiences in appropriate forms and E-waste

**Text Books:**


Reference Books:

B. Tech - III Year- I Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>Ext Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 3101</td>
<td>PC</td>
<td>Fluid Mechanics</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3102</td>
<td>PC</td>
<td>Ship Design - I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3103</td>
<td>PC</td>
<td>Ship Construction</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3105</td>
<td>PE</td>
<td>Professional Elective I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3104</td>
<td>OE</td>
<td>Open Electives I</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 3106</td>
<td>PC</td>
<td>Marine Thermal Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3107</td>
<td>PC</td>
<td>NAPA Lab</td>
<td>0</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3108</td>
<td>SC</td>
<td>Welding Practice</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM 3109</td>
<td>INT</td>
<td>Internship-I</td>
<td></td>
<td></td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

Total credits 22
NM 3101 FLUID MECHANICS

Periods/week : 4
Ses. : 30
Exam : 70

Examination Theory: 3hrs.
Credits: 3

Course Objectives: This course offers basic knowledge on fluid statics, dynamics and hydraulic machines. The objective of this course is to enable the student to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery.

Course Outcomes: The student will be able to:

- Identify importance of various fluid properties at rest and in transit.
- derive and apply general governing equations for various fluid flows
- Understand the concept of boundary layer theory and flow separation.
- Plot velocity and pressure profiles for any given fluid flow.
- evaluate the performance characteristics of hydraulic turbines and pumps

SYLLABUS

Properties of fluids- Viscosity- Pressure measurement and Manometers- Hydrostatic forces on surfaces.
One dimensional Viscous Flow: Couette flow- Plane Couette flow, Favourable pressure gradient and adverse pressure gradient- Flow through pipes- Hagen Poiseulle flow- Fannigs friction factor- Darcy's Weisbach friction
factor- Loss of head due to friction in pipes- Laminar and turbulent regimes- Flow potential and flow resistance-
Flow through branched pipes, Momentum equation- Forces due to pipe bends, Curved tubes, Sudden
enlargement, Sudden contraction, flow through porous media- Darcy’s equation. Two dimensional viscous flow:
Navier -Stokes equations and solutions- Order of magnitude analysis- Boundary layer equations. **Laminar Boundary Layer**: Momentum integral equation- Flow over a flat plate- Displacement thickness, Momentum thickness and energy thickness.

**Turbulent Boundary Layer**: Laminar- Turbulent transition- Momentum equations and Reynold's stresses-
Fully developed turbulent flow through a pipe- Turbulent boundary layer on a flat plate- Laminar sub-layer-
Boundary layer separation and control.

**Dimensional Analysis and Modeling Similitude**: Fundamental and derived dimensions- Dimensionless
groups- Buckingham p-theorem- Rayleigh method- Model testing- Types of similarity- Geometric, Kinematic
and Dynamic similarities- Hydraulic diameter.

**Compressible Fluid Flow**: Thermodynamic relations- Continuity, Momentum and Energy equations- Velocity
of sound in a compressible fluid- Mach number and its significance- Limits of incompressibility- Pressure field
due to a moving source of disturbance- Propagation of pressure waves in a compressible fluids- Stagnation
properties- Stagnation pressure, Temperature and density- Area velocity relationship for compressible flow-
Flow of compressible fluid through nozzles- Condition for maximum discharge through nozzles- Variation of
mass flow with pressure ratio- Compressible flow through a venturimeter- Pitot static tube in a compressible
flow.

**Text Book**:  

**References**:  
5. Fluid Mechanics by Kothandaraman and Rudramoorthy.
NM 3102 SHIP DESIGN-I

Periods/week : 4  
Ses. : 30  
Exam : 70  
Credits: 3

Examination Theory: 3hrs.

Course objectives: introducing basic ship theory, the ship design process, and systems engineering concepts. Hands on development of a computer code for ship hydrostatics analysis. Hands on experiments on ship stability and resistance. Visits and exercises on board ships. Individual ship design project and related workshops.

Course outcome:

This course gives an introduction to naval architecture, i.e. the engineering design of ships and other marine technology systems, and basic ship theory such as hydrostatics, stability, resistance and propulsion. The objective is that students after finishing the course shall be able to:

- Demonstrate knowledge and understanding of the scientific basis and proven experience of ship design and insight into current research and development work;
- Demonstrate methodological knowledge and understanding in ship hydrostatics, stability, resistance and propulsion;
- Demonstrate ability to model, simulate, predict and evaluate ships' hydrostatics, stability, resistance, and energy and resource efficiency, even on the basis of limited information;
- Demonstrate ability to critically, independently and creatively make the initial design of a ship for a certain transport scenario, taking into account relevant scientific, social, ethical, economic and environmental aspects, and international regulatory frameworks;
• Give an account of the international shipping markets and the corresponding stakeholders, goods flow paths, and ship types;
• Discuss the opportunities for seaborne transportation in a sustainable society and describe the shipping-related environmental problems and measures for tackling them;
• Demonstrate ability to plan and carry out advanced engineering tasks within given frames using appropriate methods and to evaluate this work;
• Demonstrate ability to clearly present and discuss engineering conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts.

SYLLABUS

General Considerations and Introduction to Ship Design Methods: Marketing, manufacturing and operational considerations in Ship design. Technological, economic and sociological factors and national priorities. Ship design as a science and as an art. Owner’s requirements, shipyard production facilities and operational constraints to be considered in the design process. Introduction to ship design method using basic ship or parent ship types, ship design as an iterative process and stages of ship design. The design spiral, design ship categories such as dead weight carriers, capacity carriers, and linear dimension ships. Displacement and volume estimation. Dead weight-displacement ratio, components of dead weight and displacement, determination of main dimensions and form coefficients, use of computers in ship design process.

Estimation of Weight And Volume Components, Design Of Hull Form And Determination Of Stability And Other Criteria:

Weight and capacity equations and their use in ship design. Use of cubic equation. Calculation of weight and volume components using parent ship data or other compiled data. Calculation of steel, wood, outfit and machinery weights, using formulas. Estimation of dead weight components, design of hull form from first principles. Sectional area curve. Design of load water line, sections, stem and stern profiles, other water lines and development of the lines plan., determination of position of the LCB. Preliminary estimation of power and propeller diameter. Preliminary check for rudder area. Use of series data such as BSRA series and Taylor’s series. Calculation of stability, free board, trims capacity and tonnage. Stowage factors. Volume required for cargo fuel fresh water and Ballast.

Determination of Engine Power and Selection of Main and Auxiliary Machinery:

Calculation of engine power. Relation between resistance and engine power. Criteria for selection of main propulsion plant. Types of main propulsion plants and fuels-their advantages and disadvantages. Different types of power transmission and shafting systems used in ships. Selection of propeller. Propeller types and number and estimation of main propeller parameters, such as diameter, rpm, number of blades, blade area ratio etc. Determination of location, area and volume of engine room. Estimation of size of engine casing. Estimation of electrical power requirement in the ship and deck area and volume required for installation of generators and main switchboard. Functions of various other auxiliary machinery such as boilers, cargo pumps, fuel and lube oil pumps, separators, cooling systems etc.

Cargo Systems and Cargo Handling Gear: Introduction to various types of cargo systems and cargo handling gear used on board ships such as cranes, derricks, Sampson posts, pumping systems etc. Properties and
requirements for carriage of different types of cargo. General cargo carriers, light and heavy bulk cargo carriers and ore carriers. Unitised cargo - pallets, containers, barges, etc. and specialised ships for their carriage. Wheeled cargoes. RO-RO ships and ferries. Liquid cargoes-oil tankers liquefied gas carriers and chemical tankers. Selection of cargo handling gear-arrangements for general, bulk, unitised and liquid cargoes. Piping arrangement for tankers.

Important Design Features of Various Types of Ships and other Considerations: General cargo carriers, container ships, oil tankers, passenger vessels, bulk carriers, fishing trawlers, tugs, dredgers, barges, ferries. Different types of hull forms, propulsion systems, main and auxiliary machinery, cargo handling systems and operational requirements suitable of the above mentioned ships. Other consideration in ship design such as water tight integrity, damage stability, manoeuvring and sea keeping criteria, propulsive efficiency, minimisation of hull vibrations, compartments and super structure design in different types of ships. Trimming calculations in various operating considerations. Ballasting arrangements and estimation of total ballast.

Reference Books:

1. Ship Design and Construction by R.Taggart
3. Principles of Naval Architecture, Vol. 1,2&3 by Ed.V. Lewis

NM 3103 SHIP CONSTRUCTION

Periods/week : 4 Ses. : 30 Exam : 70

Examination Theory: 3hrs. Credits: 3

Course Objective:

• To be well versed in how to apply various knowledge of architecture on ship operations.
• To Understand Ship Stability and Statically Stability

Course Outcome:

• CO 01: To understand the types of Ships
• CO 02: To understand the Stress and Strain in Ships in Still water and in Sea way
• CO 03: To understand the principle part of Ships
• CO 04: To understand the advantages of welding over riveting
• CO 05: To understand the concept of law of floatation
• CO 06: To understand the center of buoyancy and factors affecting the same
• CO 07: To understand the Transverse Statically stability
• CO 08: To understand the Equilibrium of Ship
• CO 09: To calculate of List while Loading, Discharging and/or shifting weights, Correction of List
• CO 10: To understand how to use of hydrostatic tables and curves as supplied to ships, Displacement/draft-curve and table, Light displacement& Load displacement

SYLLABUS

Introduction to ship building and materials used:
Joining methods of materials, non-destructive testing.

Storage and preparation of material and structural elements:
Material handling and storage, transport system in steel stockyard, material preparation Devices- cleaning, marking processes. The cutting process, Mechanical cutting, thermal Cutting, optically and numerically controlled cutting, bending of rolled and built-up sections, Plate bending. Nesting of plates.

Fabrication of sub-assemblies, units and hull erection:
Process of prefabrication, welding in prefabrication and erection stages, sub-assemblies, flat Sections, panels- flat and curved, double bottom sections, side tank units, fore-end and aftend Structures, deck and bulkhead structures. Assembly of hull-units. Erection of hull-units On building berth/dock.

Ship structural components:
Functions and details of ship structural components, framing systems, single and double Bottom construction, shell and deck plating, bulkheads, pillars, girders and hatch-coaming, Machinery casings, super structures and deck- houses. Bow and stern Structures. Bossing and Struts, bilge keels and fenders.
Out Fitting, Welding, Testing And Trials And Launching:

Various components of outfitting, consisting of systems, equipment and fittings of hull, machinery and electrical groups. Hull Preservation methods. Various outfitting methods.


References:

1. Merchant Ship Construction by D. A. Taylor
2. Ship Construction by D.J. Eyres
3. Ship Design and Construction by R. Taggart

NM 3106 Marine Thermal Lab

Periods/week : 3  Ses. : 50  Exam : 50
Examination Practical: 3hrs.  Credits: 1.5

List of experiments to be conducted:

1. Determination of flash and fire points of oil samples - using Cleveland’s apparatus
2. Determination of flash point of oil samples - using Abel’s and Pensky-Martin’s apparatus
3. Determination of kinematic viscosity - using Redwood Viscometer – I & II, Saybolt’s viscometer
5. Aniline point test,
6. Calibration of pressure gauge - dead weight tester.
7. Volumetric efficiency of reciprocating air compressor.
8. Valve timing diagrams of IC engines (2 & 4 stroke engines).
10. Experiments covering performance and other tests on Diesel Engines – Single cylinder, and Multi cylinder
11. Experiments covering performance and other tests on Petrol Engines
12. Refrigerating system and ice plant
13. Wind Tunnel

NM 3107   NAPA LAB

Lab Periods/week : 3  Sessional. : 50 Exam: 50  Credits: 1.5

Course Objectives
• The objectives of the course are to provide training and provide hands on experience to the students on NAPA software for the purpose of hydrostatic calculations and resistance calculations

Course Outcomes
• At the end of the course, the student will be in a position to model a ship using the software
• perform a detailed hydrostatic calculation
• Obtain the ship resistance

SYLLABUS
NAPA Main window features, Project Settings, Hull Modelling, Hydrostatic Calculations, Design Hydrostatics, Hydrostatics, Resistance, Report writing and explanation

NM 3108 (SC)   Welding Practice

LIST OF EXPERIMENTS:
(Practical/hands on)
Arc welding of mild steel and stainless steel plates and thermal cycle, cooling rate, macrostructure and Micro structural characterization of welds and Arc welding safety(Lap Joints)
Arc welding of mild steel and stainless steel plates and thermal cycle, cooling rate, macrostructure and Micro structural characterization of welds and Arc welding safety (Butt Joints)
Arc welding of mild steel and stainless steel plates and thermal cycle, cooling rate, macrostructure and Micro structural characterization of welds and Arc welding safety (T-joint)
Arc welding of mild steel and stainless steel plates and thermal cycle, cooling rate, macrostructure and Micro structural characterization of welds and Arc welding safety (Flange Joints)

Study Experiments (Theoretical)

Spot welding and Spot Welding safety

TIG welding TIG welding safety.

Plasma welding and Plasma welding safety.

Submerged welding and Submerged welding safety.

NM 3109 INTERNSHIP-I
# B. Tech - III Year - II Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Int Marks</th>
<th>Ext Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 3201</td>
<td>PC</td>
<td>Resistance and Propulsion</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 3202</td>
<td>PC</td>
<td>Strength of Ships</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 3203</td>
<td>PC</td>
<td>Ship Design - II</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 3204</td>
<td>PE</td>
<td>Professional Elective II</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 3205</td>
<td>OE</td>
<td>Open Electives II</td>
<td>4 0</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>NM 3206</td>
<td>PC</td>
<td>Marine Hydrodynamics Lab</td>
<td>0 3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM 3207</td>
<td>PC</td>
<td>Marine Instrumentation and Metrology lab</td>
<td>0 3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM 3208</td>
<td>PC</td>
<td>Ship Drawing - III</td>
<td>0 3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>NM 3209</td>
<td>SC</td>
<td>Soft Skills</td>
<td>1 2</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total credits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21.5</td>
</tr>
</tbody>
</table>

**Internship II**

NM 3201 RESISTANCE & PROPULSION

72
Course Objectives:
Students undergoing this course are expected:
- To understand and analyze the gas turbine engine and its components.
- To realize and analyze the thermodynamics of various component of a gas turbine engine.

Course Outcomes:
- Apply the working concept of various types of gas turbine engines in practical applications
- Differentiate between a subsonic and a supersonic inlet and further relate it to aerospace applications.
- Analyze the working concept of various types of compressors.
- Illustrate the operational and designing concepts of gas turbine blades.
- Examine the suitability of the combustion chamber & nozzle for a given gas turbine engine

SYLLABUS

**Introduction to resistance:** Concept of resistance, flow of non-viscous and viscous fluids past submerged bodies and surface of ships. Introduction to important components of resistance such as frictional resistance, wave making resistance, eddy making resistance and air & wind resistance. Dimensional analysis, conditions of similarity, corresponding speeds of ship and model. Introduction to towing tank experiments and determination of ship resistance.

**Viscous resistance and air & wind resistance:** Froude’s experiments with planks and plates, Reynold’s experiments with pipes. Turbulence stimulation, friction lines, form resistance, boundary layer separation, effect of hull roughness, appendage drag, resistance in shallow water full scale tests and ship model correlation.

**Wave resistance, estimation of total resistance and effective horsepower:** Kelvin wave pattern, waves generated by ship, wave interference, Froude’s method of resistance prediction. Resistance data presentation, estimation of total resistance and effective power, trail and service allowances. Aspects of hull form design. Statistical analysis of resistance data by regression.

**Propeller Design and hull propeller interaction:** Screw propeller terminology and geometry. Dimensional analysis and conditions of similarity. Propeller in open water. Propeller coefficients, hull-propeller interaction, wake and thrust deduction, hull efficiency, relative rotative efficiency, propulsive coefficient. Cavitation, fully cavitating propellers. Propeller design using methodical series data, design of free running propellers, propellers for tugs and trawlers. Elementary treatment including basic principles of momentum theory, blade element theory, lifting line theory and lifting surface theory of propeller. Design of propellers for a variable wake.

**Ship Propulsion devices, prediction of ship’s power and strength of propellers:** Ship Propulsion devices and their historical development, water jet propulsion, controllable pitch propellers, vertical axis propellers, shrouded propellers, tandem and contra-rotating propellers and paddle-wheels, super conducting electric propulsion. Model propulsion experiments in towing tanks and Cavitation tunnels. Ship trails and service
performance analysis, estimation of power based on model experiments and propeller design charts, use of $B\rho -$ $\delta$ charts, 


**Reference Books:**
NM 3202 STRENGTH OF SHIPS

Periods/week : 4  
Ses. : 30  
Exam : 70

Examination Theory: 3hrs.  
Credits: 3

Course objective:

The course objective is to provide students with the knowledge and application skills to meet the knowledge, understanding, and practical assessment requirements for ship construction and stability as part of the requirements for an officer in charge of the navigational watch.

Course Outcomes:

- Determine whether stresses on the ship are within the permitted limits by use of stress data
- Understand the fundamental actions to take in the event of partial loss of intact buoyancy
- Demonstrate knowledge of the fundamental actions to be taken in the event of partial loss of intact buoyancy
- Use tables and diagrams of ship stability and trim data to calculate the ship's initial stability, drafts, and trim for any given disposition of cargo and other weights
- Demonstrate knowledge of principal structural members of a ship and the proper names for various parts

SYLLABUS

Introduction to functions and analysis of ship structures: Functions of ship structure, the forces acting up on a ship at sea, static forces, dynamic forces. The distortion of ship’s structure. Application of theory and experience. Limitations of the theory. Distinction between strength and stiffness of hull girder. Forces and moments acting on ship’s structures in regular waves in head seas, and oblique seas. Nature of stresses in ship’s hull when ship is floating in still water and on a wave. Modeling of ship’s’ structures including general remarks on structural strength. Three-dimensional analysis of a ship structures (elementary treatment only). Assumptions and simplification of longitudinal strength calculations. Introduction to the use of probability theory in the assessment of longitudinal strength.


Transverse strength of hull girder and ship hull material: Transverse loads on ship’s hull such as hydrostatic loads, weights, wave loads, racking, and torsion. Effect of hatches and other openings. Strain energy method, moment distribution method and comparison of the two methods, Influence of bracketed connections.

**Mechanical properties and chemical composition of structural materials:** Testing of steels such as tensile test bend test and impact test. Brittle fracture. Steels for very low temperature applications.


**Theory of thin plates, buckling of structures, composite construction, grillage analysis, calculation of scantlings as per rules:** Thin plate theory and solution for different boundary conditions. Application of plain stress theory to ship structural problems. Case of a plate acted upon by a concentrated load; Buckling of plates. Influence of stiffeners (longitudinal and \ or transverse) on the buckling stress of ship’s plating. Bending and membrane stresses in plates (application to bulkheads, shell plates etc.) Composite construction- Two materials with same elastic modulus. Two materials of different elastic Modulii. Bending of composite beam. Introduction to Grillage. Analysis of simple Grillage.

Scantling calculations according to the rules of classification societies.

**REFERENCE BOOKS:**

1. Ship Construction by D.J.Eyres Merchant Ship Construction by D.A.Taylor

NM 3203 SHIP DESIGN – II

Periods/week : 4  
Ses. : 30  
Exam : 70  

Examination Theory: 3hrs.  
Credits: 3

Course objectives: Introducing basic ship theory, the ship design process, and systems engineering concepts. Hands on development of a computer code for ship hydrostatics analysis. Hands on experiments on ship stability and resistance. Visits and exercises on board ships. Individual ship design project and related workshops.

Course outcome:

This course gives an introduction to naval architecture, i.e. the engineering design of ships and other marine technology systems, and basic ship theory such as hydrostatics, stability, resistance and propulsion. The objective is that students after finishing the course shall be able to:

- Demonstrate knowledge and understanding of the scientific basis and proven experience of ship design and insight into current research and development work;
- Demonstrate methodological knowledge and understanding in ship hydrostatics, stability, resistance and propulsion;
- Demonstrate ability to model, simulate, predict and evaluate ships' hydrostatics, stability, resistance, and energy and resource efficiency, even on the basis of limited information;
- Demonstrate ability to critically, independently and creatively make the initial design of a ship for a certain transport scenario, taking into account relevant scientific, social, ethical, economic and environmental aspects, and international regulatory frameworks;
- Give an account of the international shipping markets and the corresponding stakeholders, goods flow paths, and ship types;
- Discuss the opportunities for seaborne transportation in a sustainable society and describe the shipping-related environmental problems and measures for tackling them;
- Demonstrate ability to plan and carry out advanced engineering tasks within given frames using appropriate methods and to evaluate this work;
- Demonstrate ability to clearly present and discuss engineering conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts

SYLLABUS


**Hull Fittings, Navigational aids and lifesaving appliances:** Closing devices, water tight, weather tight, gas tight and non-water tight floors. Windows and portholes. Bulkhead openings, hull openings, cargo port, bow doors, stern ramps. Man holes and access doors.


**Auxiliary machinery and other Ship Systems:** Ship auxiliaries and equipment. Functions of auxiliary machinery and design requirements for location and installation. Selection of components and space allocation for ship systems including electrical system, Fuel and lubricating oil systems. Fresh water and sea water systems, Air conditioning, ventilation, and refrigeration systems, anchoring and mooring gear,

Steering gear types and location, automation of ship systems and ship operation. Unmanned machinery spaces.

**International and National regulatory Bodies:** Safety and habitability. Impact of the regulatory bodies in ship design, IMO and classification societies, SOLAS, ILLC, ITTC, MMD. Prevention of marine pollution-MARPOL regulations. Free board assignment. Stability in various operating conditions, important features of maritime law of India -regulations regarding a/c, ventilation, noise, vibrations. Survival after damage. Carriage of dangerous goods. Collision prevention.

Ship design organisation and design consideration for special ships and use of computers: Evolution of design philosophy. Changes effected over the years. The “Titanic Disaster” and impact.

Design features of special types of ships- ice breakers, refrigerated cargo carriers, liquefied gas carriers, aircraft carriers, Ro-RO vessels, SWATH vessels, luxury passenger ships and high speed ships.


**Reference Books:**

1. Ship Design and Construction by R.Taggart
2. Principles of Naval Architecture, Vol. 1,2&3 by Ed.V. Lewis
NM 3206  MARINE HYDRODYNAMICS LAB

Periods/week :3  Ses. : 50  Exam : 50
Examination Practical: 3hrs.  Credits: 1.5

Experiments covering the following aspects:

- Pressure, Velocity and flow rate measurements,
- Calibration of Venturimeter.
- Reynolds number of steady pipe flow.
- Calibration of small orifices and mouth pieces.
- Calibration of orifice meters and flow nozzles.
- Vortex motion on the aft portion of blunt bodies.
- Pressure distribution around aerofoil sections.
- Determination of metacentric height of a floating model.
- Visits to Model testing tank to do ship model testing and understand basic facilities.

NM 3207 MARINE INSTRUMENTATION AND METROLOGY LAB

Periods/week: 3  Ses. : 50 Exam: 50
Examination Practical: 3hrs  Credits: 1.5

Metrology experiments

- Calibration of mechanical comparator
• Calibration of Micrometer
• Testing of Concentricity trueness and parallelism of a mandrel
• Measurements of taper bar using Dial gauge, bevel protractor and sine bar.
• Distance between two holes of a template using Vernier height gauge.
• Measuring the central height of a circular spigot
• Measuring the pitch diameter, diametral pitch and pressure angle of an involute spur gear
• Study of flatness of slip gauges using optical flats and monochromatic light.
• Calibration of Vernier calipers.
• Calibration of Vernier Height gauge

Instrumentation experiments

• Calibration of thermocouple, thermisiters.
• Calibration of force and stresses using strain gauges.
• Flow rate measurement and roto meter.
• Calibration of pressure gauge.

NM 3208 SHIP DRAWING – III

Periods/week : 3

Examination Theory: 3hrs.

Credits: 1.5


Practical: Drawing of Stability Curves, Analysis of inclining experiment and weight calculations, LCG and VCG calculation

NM 3209 (SC) Soft Skills
**Course Objectives:**

1. To develop skills to communicate clearly.
2. To aid students in building interpersonal skills.
3. To enhance team building and time management skills.
4. To inculcate active listening and responding skills.

**Course Outcomes:**

2. Apply the conceptual understanding of communication into everyday practice.
3. Understand the importance of teamwork and group discussions skills.
4. Develop time management and stress management.

**Syllabus**

**Introduction to Soft Skills:** Communication – Verbal and Non Verbal Communication - Personal grooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact, Space Distancing, Presentation Skills, Public Speaking, Just a Minute (JAM) sessions, Adaptability.

**Goal Setting and Time Management:** Immediate, Short term, Long term, Smart Goals, Strategies to Achieve goals, Types of Time, Identifying Time Wasters, Time Management Skills, Stress Busters.

**Leadership and Team Management:** Qualities of a Good Leader, Team Dynamics, Leadership Styles, Decision Making, Problem Solving, Negotiation Skills.

**Group Discussions:** Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance), Group Behaviour, Analysing Performance.

**Job Interviews:** Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening, Body-Answer Q, Close-Ask Q), Telephone Interviews, Types of Questions.

**Reference Books:**

5. Rizvi, Ashraf M. *Effective Technical Communication:* India, McGraw-Hill Education. 2010
### B. Tech - IV Year - I Semester

<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Int Marks</th>
<th>Ext Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 4101</td>
<td>PE</td>
<td>Professional Elective III</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4102</td>
<td>PE</td>
<td>Professional Elective IV</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4103</td>
<td>PE</td>
<td>Professional Elective V</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4104</td>
<td>OE</td>
<td>Open Electives III</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4105</td>
<td>OE</td>
<td>Open Electives IV</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4106</td>
<td>HSS</td>
<td>Elective</td>
<td>4</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>NM 4107</td>
<td>SC</td>
<td>Advanced NAPA Practice</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>NM4108</td>
<td>INT</td>
<td>Internship-II</td>
<td></td>
<td></td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total credits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22</td>
</tr>
</tbody>
</table>
NM 4107 (SC) Advanced NAPA Practice

Lab Periods/week : 3  Sessional. : 50 Exam: 50  Credits: 1.5

Course Objectives
- The objectives of the course are to provide training and provide hands on experience to the students on NAPA software for the purpose of hydrostatic calculations and resistance calculations

Course Outcomes
- At the end of the course, the student will be in a position to model a ship using the software
- Perform a detailed hydrostatic calculation
- Obtain the ship resistance

SYLLABUS
NAPA Main window features, Project Settings, Hull Modelling, Hydrostatic Calculations, Design Hydrostatics, Hydrostatics, Resistance, Report writing and explanation

B. Tech -IV Year- II Semester
<table>
<thead>
<tr>
<th>Course code</th>
<th>Category</th>
<th>Course Title</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 4201</td>
<td>PROJ.</td>
<td>Project work</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>14</td>
</tr>
</tbody>
</table>

Total credits 14

PROFESSIONAL ELECTIVES:

I. INTRODUCTION TO OFFSHORE STRUCTURES

Periods/week : 4
Examination Theory: 3hrs.
Ses. : 30 Exam : 70 credits: 3

Course Objectives: This subject introduces students to basic naval architectural knowledge e.g. naval architectural terms, ship components and simple hydrostatics calculations. It also enables students to familiarize themselves with various offshore engineering sectors including basic knowledge on types of offshore structures and their functions.

Course outcomes:
On successful completion of this unit, students should be able to:
- Appreciate the shipbuilding industry
- Acquire the naval architectural principles and concepts
- Use the methods of numerical integration and quadrature
- Describe in detail a number of different offshore facility concepts, including the advantages and

84
Disadvantages of each understand the various types of fixed and floating offshore platforms, including key design, fabrication
And installation issues, as well as areas of applicability describe in detail a number of ships from recreational to naval, small to big, operating on or under the
Sea acquire the basic knowledge of mooring systems and subsea technology

SYLLABUS

Fundamentals of physical oceanography, drilling technology, mooring systems, study of Environmental forces i.e. waves, wind, tides and current. Types of drilling rig suitability for particular applications. Drill ship- special equipment and operation of drilling rigs- supply crafts, structural arrangements, and semi-submersibles. Various types of offshore structures- jacket platforms, gravity platforms, complaint structures- guyed tower, tension leg platform etc. Structural systems used. Load calculation- wave, wind, current and functional loads, Soil structure interaction. Analysis of offshore structural components matrix methods-plane frame, grid and space frames. Introduction to dynamic analysis, transportation, launching and upending problems, preliminary design aspects of offshore structures. Safety and reliability of offshore structures.

REFERENCE BOOKS:
2. Offshore Structural Engineering by Thomas H.Dawson

II. OCEAN STRUCTURES AND MATERIALS

Periods/week : 4  
Ses. : 30  
Exam : 70  
Examination Theory: 3hrs.  
credits: 3

Course Objectives: This subject introduces students to ocean structure knowledge e.g. naval architectural terms, ship components and simple hydrostatics calculations. It also enables students to familiarize themselves with various offshore engineering sectors including basic knowledge on types of offshore structures and materials

Course outcomes:
On successful completion of this unit, students should be able to:
- Appreciate the knowledge on Oil and gas resources
- Acquire the Metal principles and concepts
- Use the methods of design and construction
- Describe in detail a number of different Materials facility concepts,

SYLLABUS

Brief introduction of ocean, Oil and gas resources. Near shore structures. Different types of ocean structures and systems (fixed, floating, semi-submersibles, submersibles, TLP’s pipelines, intakes) for exploitation of oil and gas, minerals and energy.


85
**Brief outline of planning,** design and construction. Regulation and codes of practices The environment and environmental forces. Structural analysis and principles of design Foundation and sea bed anchors. Towing, launching and installation.

**References :**


III. FINITE ELEMENT ANALYSIS

Periods/week : 4
Examination Theory: 3hrs.

Ses. : 30
Exam : 70

credits: 3

Course Objective:
• To introduce the concepts of Mathematical Modeling of Engineering Problems.
• To appreciate the use of FEM to a range of Engineering Problems

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

• CO1: apply direct stiffness, Rayleigh-Ritz, Galerkin method to solve engineering problems and outline the requirements for convergence.
• CO2: analyze linear 1D problems like bars and trusses; 2D structural problems using CST element and analyse the axi-symmetric problems with triangular elements.
• CO3: write shape functions for 4 and 8 node quadrilateral, 6 node triangle elements and apply numerical integration to solve; 1D and 2D; stiffness integrations.
• CO4: solve linear 2D structural beams and frames problems; 1D heat conduction and convection heat transfer problems.
• CO5: evaluate the Eigenvalues and Eigenvectors for stepped bar and beam, explain nonlinear geometric and material non linearity

SYLLABUS


Two-dimensional Problems Using Constant Strain Triangles: Introduction, Finite element modeling, Constant strain triangle, in plane and Bending, problem modeling and boundary conditions.


Text Book:
1. Introduction to Finite Elements in Engineering, by Tirupathi R. Chandrupatla, Ashok D. Belegundu (chapters 1 to 8 only).

References:
1. Introduction to Finite Element Method, by Abel & Desai.
IV. MARINE MANUFACTURING TECHNOLOGY

Periods/week : 4
Exam : 70
Ses. : 30
Credits: 3

Examination Theory: 3hrs.

Course outcome: Introduce students to theory and operation of manufacturing including manufacturing processes and equipment overview, manufacturing design, production process and flow, materials, machine operations and logistics.

Course objective:

- Identify the different stages of a manufacturing process.
- Interpret the elements of the product design process.
- Identify the common machines used in a manufacturing process.
- Explain the operations and capabilities of machines used in manufacturing.
- Determine the operations used in finishing manufactured products.
- Explain the operations and capabilities of automated machines used in manufacturing.
- Interpret the functionality of base lining and documentation in a manufacturing process.
- Determine the main elements of quality assurance in a process.
- Identify characteristics of end product logistics.

SYLLABUS


Lathe: Working principle, classification, specification, different operations on a lathe, methods of taper turning, cutting speed, feed, depth of cut, machining time and power required for cutting. Turret and capstan lathes.

Shaper and Planer (Elementary Treatment only): Principal parts, classification – quick return mechanisms, table feed mechanism working on shaper and planer, a comparison. Work holding devices.

Drilling and Boring Machines (Elementary Treatment only): Classification, specifications, cutting speed, feed, machining times, parts and description of boring machines, types.


Linear and angular measurements: Micrometers, Slip gauges, Vernier and optical bevel Protractors, sine bar Angle gauges.

Comparators: Types, Mechanical, Electrical, Electronic comparators. Measurement of Straightness- flatness- square ness and symmetry- parallelism and circularity.

Metrology: Metrology of screw threads and Metrology of gears (Measurement of Pitch and tooth thickness only).


Text Books:
1. Engineering Metrology by R.K. Jain
2. Production Technology by R.K. Jain and S.C. Gupta
References:
1. Production Technology by P.C. Sharma
2. Workshop Technology, Vol.1, 2&3 by W.A.J. Chapman
3. Machine Tools by Bhattacharya

V. FISHING VESSELS TECHNOLOGY

Periods/week : 4             Ses. : 30             Exam : 70
Examination Theory: 3hrs.              Credits: 3

SYLLABUS


Fishing Gear- Towed gear, Bottom trawling, side trawling, Towing arrangements, stern trawling operations and equipment, multiring trawling, Midwater trawling, Purse seining Types, Analysis of fishing nets.

Storing and preservation of fish on board a vessel, Fish hold arrangement. Insulation, icing and freezing. Refrigeration machinery.


Economics of fishing vessels. Estimation of initial and operation costs. The influences of size, speed, power, selling price, distance optimised fishing vessel design. Design and economics of simple low cost country fishing crafts.

References Books:
1. Design of Small Fishing Vessels by John Fyson
2. Fishing Boats of the World by Jan-Olof Traung

VI. MARINE HYDRODYNAMICS

Course Objectives: To provide students with a sufficient introduction to each of the topics of the course so that he/she will be able to understand the background of current literature in the hydrodynamics of marine vehicles, offshore engineering, and other ocean-related activities.

Course Outcomes: Students with ocean- and marine-related interest will develop the necessary theoretical and experimental background to keep up with existing literature and begin research on contemporary topics.
SYLLABUS

Small Amplitude Wave Theory Formulation and Solution: Review of hydrodynamics-Boundary Value Problems, summary of two-dimensional periodic water wave BVP, solution of linearized water wave BVP for a horizontal bottom, dispersion equation, engineering wave properties-water particle, kinematics of progressive waves, pressure field under a standard wave, partial standing waves, energy and energy propagation in progressive waves- principle of conservation of energy. Energy Flux.

Wave Forecasting: Generation of waves-theories of wave generation by Kelvin, Phillips, Milne, Jeffrey, Swerdrup and munk. Concept of fully developed sea, Characteristics of ocean waves, significant wave height and period, wave height variability, energy spectra of waves, simplified wave prediction models-SMB and PNJ. Methods, wave forecasting charts, effects of moving storms and variable wind speed and direction.

Wave Transformation and Wave statistics: Transformation of wave entering shallow water, shoaling of waves in shallow water, wave reflection, refraction and diffraction, combined refraction, diffraction, and wave breaking. Wave Height distribution-single wave train, wave groups, narrow banded spectra, Rayleigh’s distribution, wave spectrum, directional wave spectrum-JONSWAP, PNJ and Bretschneider spectra.

Wave Forces: Wave forces on vertical cylindrical bodies due to non-breaking waves – Basic concepts, calculations of forces and moments, Transverse forces due to eddy shedding (Lift forces), selection of hydrodynamic force coefficient, C_d and C_m, calculation of forces and moments on groups of vertical and non-vertical cylindrical bodies due to breaking and non-breaking waves.

Text Book:


Reference Books:

1. Water Wave Mechanics by Dean and Dlrymple
2. An introduction to Hydrodynamics and Water Waves by B. Le Mehaute
3. Estuary and Coastline Hydrodynamics by A.T. Ippen
VII. ADVANCED WELDING TECHNOLOGY

Periods/week : 4                                    Ses. : 30                                        Exam : 70
Examination Theory: 3hrs.                                        Credits: 3

SYLLABUS

Introduction: Classification of welding and related processes. General conditions for welding, edge preparations, and design of welded joints, welding codes and symbols, weldability of metals and metallurgy in welding.

Gas Welding: Principle, equipment, different gas flames, gas welding techniques, types of gas welding, oxy-acetylene, air-acetylene, and oxy-hydrogen welding etc.

Arc Welding: Principle and theory. Arc welding equipment, arc welding current and voltage, polarity of electrodes, angularity of electrodes, precautions in arc welding. Arc welding types, Carbon arc, metal arc, MIG, TIG etc.

Solid State Welding: Principle and types. Latest welding techniques, electron beam, laser beam, metal flame spraying etc. Under water welding (elementary treatment only). Related processes, oxy-acetylene cutting, arc cutting, brazing, soldering etc.

Welding of various Metals: Cast Iron, steel, non-ferrous metals, etc. Welding defects, inspection and testing-design for welding. Safety practices and training in welding and welding machines (elementary treatment).

Text Books:
1. Welding Engineering by R.L. Agrawal and Tahil Manghnani
VIII. SEA KEEPING AND MANEUVERABILITY

Periods/week : 4
Ses. : 30
Exam : 70
Examination Theory : 3hrs.
Credits: 3

Course outcomes:

- Apply the concepts of Static Equilibrium and Archimedes’ Principle to the operation of a ship.
- Demonstrate the ability to assess the stability condition of a ship. Predict the effect of planned shipboard evolutions on ship stability.
- Understand the significance of damage to a ship which has compromised its watertight integrity. Use hydrostatics to make intelligent and safe choices to maintain a ship afloat and upright.
- Understand the structural arrangement of a ship, including the choice of materials and the stresses developed by loads encountered in its operating environment.
- Understand the different components that make up a ship’s resistance and the manner in which the propulsion plant transmits its power to overcome those forces.
- Understand factors affecting the seakeeping and maneuverability of ships in a seaway.

Course objective:

This course is an introduction to the applied science of ship systems. The course describes ships and submarines and how they remain afloat from a design and application perspective. Included are topics in hydrostatics, ship stability and operability, materials, fluid dynamics and propulsion.

SYLLABUS

Introduction to sea keeping: Importance of sea keeping analysis. Behaviour of a ship in a seaway. Regular waves, Sinusoidal and trochoidal Theories. Characteristics of waves; Sea surface. Analytical and statistical


Ship Motions in Irregular waves: Encounter spectrum. Response amplitude operators and their calculation by theory and experiment. Motion spectrum and statistical characteristics of motions in irregular waves.


Stabilization of ship motions: Roll stabilizers- Bilge keels, Gyroscopic stabilizers, Movement of weight, Rudder action, Jet flaps, Stabilizing fins, Passive and Active tank stabilisers.


References:

1. Dynamics of Marine Vehicles by Rameshwar Bhattacharya.
2. Principles of Naval Architecture, Vol. III by Ed.V. Lewis
IX DYNAMICS OF OFFSHORE STRUCTURE

Periods/week : 4
3hrs.

Ses. : 30 Exam : 70 Examination theory:

Credits: 3

SYLLABUS


**Structures in the offshore environment** - Description of typical offshore structures – Fixed- Compliant Floating - Solid fluid interaction parameters - Spring factor - Added mass and damping Response of offshore structures - Modelling of offshore structures – single and multi-degree freedom systems – effect of foundations


**Experimental Structural Dynamics.** Experimental studies-free floating studies-free decay studies. Experimental investigation on perforated cylinders & perforated TLP model. Structural dynamics, introduction
to stochastic dynamics of ocean structures. Motion analysis in random waves - Low frequency oscillation. Dynamic positioning.


**References**


---

**X. DESIGN OF SMALL CRAFTS**

Periods/week : 5  
Ses. : 30  
Examination Theory: 3hrs.  
Exam : 70  
Credits: 4

**Course objectives:** provides a broad overview of craft design, construction and operation. The craft design process may be broken down broadly into two stages: Conceptual and/or preliminary design. The preliminary design process will normally take the form of a techno-economic appraisal, using a fundamental engineering economy approach.

**Course outcome:**

- demonstrate ability to critically, independently and creatively make the initial design of a ship for a certain transport scenario, taking into account relevant scientific, social, ethical, economic and environmental aspects, and international regulatory frameworks;
- give an account of the international shipping markets and the corresponding stakeholders, goods flow paths, and ship types;
- discuss the opportunities for seaborne transportation in a sustainable society and describe the shipping-related environmental problems and measures for tackling them;
• demonstrate ability to plan and carry out advanced engineering tasks within given frames using appropriate methods and to evaluate this work

SYLLABUS

Tugs and towing vessels: Types, stability requirements, Bollard pull, powering, Features of tow hook, Equipment. General arrangement, Special features of pusher tugs, Kort-nozzle, Voith-Schneider and Schottel propulsion in tugs. Design aspects.


High speed crafts: Their role in offshore and naval operations. Special features. Design considerations


Text Books:
1. Principles of Naval Architecture by Ed.V. Lewis

XI NAVAL VESSELS

Periods/week : 4
Ses. : 30 Exam : 70 Examination
Theory: 3hrs.
Credits: 3

SYLLABUS


**Detailed study of some modern naval ships:** Submarine: General description, pressure hull external structure, diving and surfacing systems. A/C and ventilation systems. Stability, equilibrium polygon. Distance when submerged and while on surface. Propulsion system. Rudder and hydroplanes. Nuclear submarines.

---

**XII. ADVANCED SHIP THEORY**

**Course Objectives:**
- The objectives of the course are
- Teach the student about the various hazards during the life of a marine engineer and the protection that should be provided against those Hazards
- Teach the students how to design a Ship Girder
- Teach the student how to design internal members like panel etc
- Teach the student about the internal and external factors of marine engineers life.

**Course Outcomes**
- At the end of the course the student will
- Be in a position to know about Various Hazards and protection and the environmental pollution aspects of ship’s life
- Be capable of performing simple standard calculation for the ship girder,
- Be capable of structural Design of Stiffened plating, panels plating frameworks etc
- Know about the internal and external environmental aspects of the Ship Environment

**SYLLABUS**

Hazards and Protection - Flooding and collision Safety of Life at Sea (SOLAS), Abnormal Waves, Environmental Pollution

LO-1:
To explain Hazards and protection
- The Ship Girder - Standard calculation for the ship girder, materials considerations,
- Structural Design and Analysis - Stiffened plating, panels plating, frameworks, realistic assessment of structural elements, Fittings

LO-2:
To provide Design and Analysis of the ship girder
- The Ship Environment and Human Factors - The external environment - sea, waves, climate, physical limitations, internal environment, motions, vibration and noise

LO-3:
To Explain Human Factors and Ship environment

**Textbook**
Basic Ship Theory by Rawson and Tupper – B&H

**References**
- Muckle’s Naval Architecture, by Eric Tupper – B&H
- Principles of Naval Architecture – SNAME Publications
XIII. UNDER WATER ACOUSTICS

Periods/week : 4
Ses. : 30 Exam : 70 Examination
Theory: 3hrs. Credits: 3

Introduction Sound

Wave motion, Sound pressure, Reference intensity, Source level, Radiated power, Limitations to sonar power, Cavitation, Interaction, Changes to arrays, Projector sensitivity, Hydrophone sensitivity, Spectrum level, Sound in air and in sea water,

Arrays

Need for projector arrays, Need for hydrophone arrays, Beam patterns, Directivity of a dipole, The general line array, Shading, Shaded arrays: transmit source levels, Directivity index, Line array: beam pattern vs. steer angle, Broadside array: length and spacing, Beam pattern for a continuous line, DI of a simple dipole, DI of a line array, DI of a planar array, DI of a cylindrical array, DI formulae based for simple arrays, Conformal arrays, Spherical arrays, Volumetric arrays, Beam formers, Domes and arrays.

Propagation of Sound in the Sea

Propagation loss, Losses, Spreading losses, Absorption losses, Spherical spreading and absorption, Propagation in the real ocean, The speed of sound, Sound speed profiles, Deep sound channel, Reliable acoustic path, Surface duct propagation, Convergence zone propagation, Bottom bounce propagation, Propagation loss models, Ray theory and the Hodgson model, Hodgson example, Performance prediction, Multipath propagation

Target Strength

Definition, Formulae, Measurement, Dependence on pulse type and duration, TS of a sphere, TS of some simple shapes, TS of small targets, Mine target strength, Torpedo target strength, Submarine echoes, Beam aspect target strength, Bow aspect target strength, Submarine target strengths, Towed arrays, Target strength reduction, Practical values.

Noise in Sonar Systems

Sources of noise, Thermal noise, Noise from the sea, Noise from a vessel, the sonar environment, Self-noise Electrical noise, Machinery noise, Flow noise, Propeller noise, Variation with speed, Variation with frequency, Directivity, Self-noise and radiated noise, Addition of noise levels, Receiver noise factor, Noise factor of a sonar, Acceptable receiver noise level, Alternative calculation, Practical values

Reverberation

Sources of reverberation, Scattering and reflection, Boundary roughness, Classes of reverberation, Backscattering strength, Reverberation target strength, Volume reverberation, Boundary reverberation, Scattering layers, Volume scattering strength, Sea surface scattering strength, Bottom scattering strength, Variation with fi-equency, Reverberation under ice.

The Sonar Equations

100
The basic sonar equation, The basic passive equation, The basic active equation, Detection threshold and detection index, Receiver operating characteristics, ROC curves,

**Passive Sonar**

Radiated noise, Radiated noise: source level, Nature of radiated noise, Practical values, Broadband and narrowband, Normalization, A Note on Swaths, Passive arrays, Passive aural, Passive displays, Formulae for detection threshold, Broadband square law detector, Broadband cross-correlator detector, Narrowband processor, Narrowband amplitude detector processor, Passive ranging, Triangulation, Vertical direct passive ranging, Horizontal direct passive ranging, Towed arrays, Bearing ambiguity, Self-noise,

**Active sonar**

Pulse types, Active sonar equations, Reverberation index, Reverberation and Target Echoes in the main lobe, and sidelobes, Range, pings and doppler shift, Reverberation rejection by CW pulses, Practical reverberation envelopes, Fullband half-beam processing, Beam forming, FM phase binning process, CW processing, Large aperture array, Detection performance, Noise and reverberation-limited detection ranges:, Ambiguity diagrams, Very long pulses, Operational degradation factor, Active displays, Unified detection and classification, Bandwidth, Beamwidth, CADAC, Levels of CADAC, CADAC and pulse features, Statistical analysis, Amplitude profiles, Multipath affects classification

**Textbook:**


2. Understanding Active Noise Control C.H. Hansen

3. Underwater Acoustic Systems Rodney F.W. Coates

4. Underwater acoustics Leon Camp
XIV. MARINE ENGINEERING -II

Periods/week : 4
Theory: 3hrs.
Ses. : 30 Exam : 70 Examination
Credits: 3

Engine room arrangements for different power plants – Functions of Auxiliary equipment – Bilge and ballast systems – Other Auxiliaries.

Piping – Piping fittings and valves – Control valves, materials and corrosion in pipes – Colorcodes – Steam traps, Drains and glands.


Steering gear- Types of Steam steering gear, Telemotor gear, Hand steering gear, Hydraulic systems, Electro hydraulic steering gear – Electrical steering gear.

Text Books:
1. The running and maintenance of marine Machinery - J Cowley.
3. Marine Auxiliary machinery and systems - M Khetaguroo
4. Theory and design of steam and gas turbines – Lee
XV. ADVANCED FLUID MECHANICS

Periods/week : 4
Ses. : 30 Exam : 70 Examination
Theory: 3hrs.
Credits: 3

Course Objectives: This course offers basic knowledge on fluid statics, dynamics and hydraulic machines. The objective of this course is to enable the student to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery.

Course Outcomes: The student will be able to:

- Identify importance of various fluid properties at rest and in transit.
- Derive and apply general governing equations for various fluid flows
- Understand the concept of boundary layer theory and flow separation.
- Plot velocity and pressure profiles for any given fluid flow.
- Evaluate the performance characteristics of hydraulic turbines and pumps

SYLLABUS


One dimensional Viscous Flow: Couette flow- Plane Couette flow, Favourable pressure gradient and adverse pressure gradient- Flow through pipes- Hagen Poiseulle flow- Fannig's friction factor- Darcy's Weisbach friction factor- Loss of head due to friction in pipes- Laminar and turbulent regimes- Flow potential and flow resistance- Flow through branched pipes, Momentum equation- Forces due to pipe bends, Curved tubes, Sudden enlargement, Sudden contraction, flow through porous media- Darcy's equation. Two dimensional viscous flow: Navier-Stokes equations and solutions- Order of magnitude analysis- Boundary layer equations. Laminar Boundary Layer: Momentum integral equation- Flow over a flat plate- Displacement thickness, Momentum thickness and energy thickness.

Turbulent Boundary Layer: Laminar- Turbulent transition- Momentum equations and Reynolds's stresses- Fully developed turbulent flow through a pipe- Turbulent boundary layer on a flat plate- Laminar sub-layer- Boundary layer separation and control.

Compressible Fluid Flow: Thermodynamic relations- Continuity, Momentum and Energy equations- Velocity of sound in a compressible fluid- Mach number and its significance- Limits of incompressibility- Pressure field due to a moving source of disturbance- Propagation of pressure waves in a compressible fluids- Stagnation properties- Stagnation pressure, Temperature and density- Area velocity relationship for compressible flow- Flow of compressible fluid through nozzles- Condition for maximum discharge through nozzles- Variation of mass flow with pressure ratio- Compressible flow through a venturimeter- Pitot static tube in a compressible flow.

Text Book:

References:
5. Fluid Mechanics by Kothandaraman and Rudramoorthy.

OPEN ELECTIVES:

I. INDUSTRIAL ELECTRONICS

Periods/week: 4 Ses.: 30 Exam: 70
Examination Theory: 3hrs. Credits: 3

SYLLABUS

Devices: Semi-conductor diode, Zenor diode - Transistor - Silicon control rectifier.
Rectifiers, Amplifiers, Oscillators, Cathode ray oscilloscope.

Industrial Applications: Poly-phase rectifiers - Control circuits - Motor speed control voltage control, Time delay relay circuits - Photo electric circuits.
Resistance welding, inducting heating - Dielectric heating.

Servomechanism: Open loop and closed loop systems (Elementary treatment only).

Introduction to Digital Electronics: Fundamentals of digital electronics, Number system and codes, Logic gates, Boolean algebra, Arithmetic - logic units, Flip-flops, Registers and counters, Memories: ROM, PROM, EPROM and RAM.

Introduction to Microprocessors: The Intel-8085 microprocessor; Architecture, Instruction set, Execution of instructions, Addressing structures, Timing and machine cycles of 8085 and programming I/O operations, Interrupts, Serial input and serial output, Programming the I/O ports, Programming the timer.

Text Books:
1. Industrial Electronics by Mithal (Khanna Publications).

References:

3. Industrial Electronics by Bhatacharya, Tata Mc-Graw Hill.

II. NAPA /RHINO /EXACT FLAT LAB

III. MARINE INSTRUMENTATION AND CONTROL

Periods/week : 4 Ses. : 30 Exam : 70 Examination
theory: 3hrs. Credits: 3

SYLLABUS

Instrumentation: Concepts of measurements, static performance, characteristics accuracy of measurement and its analysis. Instrumentation, for measurement: Force, torque, strain, pressure, flow, temperature and vibration.

Optical Methods of Measurement: Introduction, Laser beam as a light pointer, length/displacement measurement, temperature sensors, seismographic measurement. Introduction to fiber optics, fiber types, properties of optical fibres and a fibre optic sensor configuration.


**Frequency-domain Analysis of Control Systems:** Introduction, Nyquist stability criterion, Application of the Nyquist criterion, Stability of multi loop systems, Stability of linear control systems with time delays.

**Text Books:**
1. Automatic Control Systems, by Benjamin C. Kuo.

**References:**

---

**IV SHIP VIBRATION**

Periods/Week : 5.  
Ses. : 30  
Exam : 70  
Credit : 4  
Examination Theory: 3hrs.

**Course objective:**
Presentation of the basic notions of the vibration theory and ship vibration. Definition of vibration problems and consideration of possibilities for their solutions. Reliable prediction of vibration level in the ship design stage. Review of vibration measurement procedures and vibration remedy.

**Course outcomes:**
Upon completion of the course, students will be able to:

- understand basic principles of ship vibration.
- prepare input data for global hull-girder ship vibration analysis.
- apply analytical and numerical solutions of free and forced global hull-girder vibration.
- apply FEM to ship vibration problems.
- understand problem of the fatigue of ship structural details and calculation procedures for estimation of the fatigue life.

**SYLLABUS**


**Structural Design Of Bottom, Side Shell, Bulkhead, Deck, Fore-End, Aft-End Structures:**


**Reference Books:**

1. **Strength Of Ship Structures By W. Muckle**
2. **Ship Construction By D.J. Eyers**
3. **Principles Of Naval Architecture By Ed.V. Lewis**
4. **Ship Design And Construction By R. Taggart**

---

**V. CASD (COMPUTER AIDED SHIP DESIGN)**

Periods/week : 4
Examination Theory: 3hrs.
Ses. : 30
Credits: 3
Exam : 70

**Course Objective:** To acquaint and equip with the computer aided design and manufacturing of farm machinery with the help of CAD.

**Course outcomes:** Successful achievement of master level outcomes is required to receive a passing grade in the course.

- Ability to create fully constrained solid models that can be quickly modified using standard software tools.
- Ability to use, identify and explain standard features in solid modeling including protrusions, revolutions, cutouts, and patterns.
- Ability to use standard software tools to create engineering drawings, or other documents, to fully describe the geometries and dimensions of parts, as well as to document assemblies according to standard practice.
- Ability to use standard software tools to create part assemblies and check for clearances.
- Ability to create the drawings of farm implements and their analysis.
- Ability to write the CNC part programming.
SYLLABUS

Fundamentals of CAD - Introduction - The design process - Application of computers for design - Operating systems - Hardware in CAD: The design work station - I/O Devices - CAD system configuration - Creating database for manufacturing - Benefits of CAD.


Introduction to Finite Element Analysis - CAD techniques to finite element data preparation- Automatic mesh generation- presentation of results - 3-dimensional shape description and mesh generation- CAD applications of FEM. Database systems, structures, entity-relation models, Application to ship design, model manufacturing and testing, CAD applications in ship building, Computer aided manufacture, Numerical control, Part programming.

Text Books:

References:
6. CAD/CAM/CIM by Radhakrishna, New age international.

VI. UNDER WATER ACOUSTICS

Periords/week : 4
Ses. : 30 Exam : 70 Examination
Theory: 3hrs. Credits: 3

Introduction Sound

Wave motion, Sound pressure, Reference intensity, Source level, Radiated power, Limitations to sonar power, Cavitation, Interaction, Changes to arrays, Projector sensitivity, Hydrophone sensitivity, Spectrum level, Sound in air and in sea water,

Arrays

Need for projector arrays, Need for hydrophone arrays, Beam patterns, Directivity of a dipole, The general line array, Shading, Shaded arrays: transmit source levels, Directivity index, Line array: beam pattern vs. steer angle, Broadside array: length and spacing, Beam pattern for a continuous line, DI of a simple dipole, DI of a line
array, DI of a planar array, DI of a cylindrical array, DI formulae based for simple arrays, Conformal arrays, Spherical arrays, Volumetric arrays, Beam formers, Domes and arrays.

**Propagation of Sound in the Sea**

Propagation loss, Losses, Spreading losses, Absorption losses, Spherical spreading and absorption, Propagation in the real ocean, The speed of sound, Sound speed profiles, Deep sound channel, Reliable acoustic path, Surface duct propagation, Convergence zone propagation, Bottom bounce propagation, Propagation loss models, Ray theory and the Hodgson model, Hodgson example, Performance prediction, Multipath propagation

**Target Strength**

Definition, Formulae, Measurement, Dependence on pulse type and duration, TS of a sphere, TS of some simple shapes, TS of small targets, Mine target strength, Torpedo target strength, Submarine echoes, Beam aspect target strength, Bow aspect target strength, Submarine target strengths, Towed arrays, Target strength reduction, Practical values.

**Noise in Sonar Systems**

Sources of noise, Thermal noise, Noise from the sea, Noise from a vessel, the sonar environment, Self-noise Electrical noise, Machinery noise, Flow noise, Propeller noise, Variation with speed, Variation with frequency, Directivity, Self-noise and radiated noise, Addition of noise levels, Receiver noise factor, Noise factor of a sonar, Acceptable receiver noise level, Alternative calculation, Practical values

**Reverberation**

Sources of reverberation, Scattering and reflection, Boundary roughness, Classes of reverberation, Backscattering strength, Reverberation target strength, Volume reverberation, Boundary reverberation, Scattering layers, Volume scattering strength, Sea surface scattering strength, Bottom scattering strength, Variation with frequency, Reverberation under ice.

**The Sonar Equations**

The basic sonar equation, The basic passive equation, The basic active equation, Detection threshold and detection index, Receiver operating characteristics, ROC curves,

**Passive Sonar**

Radiated noise, Radiated noise: source level, Nature of radiated noise, Practical values, Broadband and narrowband, Normalization, A Note on Swaths, Passive arrays, Passive aural, Passive displays, Formulae for detection threshold, Broadband square law detector, Broadband cross-correlator detector, Narrowband processor, Narrowband amplitude detector processor, Passive ranging, Triangulation, Vertical direct passive ranging, Horizontal direct passive ranging, Towed arrays, Bearing ambiguity, Self-noise,

**Active sonar**

Pulse types, Active sonar equations, Reverberation index, Reverberation and Target Echoes in the main lobe, and sidelobes, Range, pings and doppler shift, Reverberation rejection by CW pulses, Practical reverberation envelopes, Fulland half-beam processing, Beam forming, FM phase binning process, CW processing, Large aperture array, Detection performance, Noise and reverberation-limited detection ranges:, Ambiguity diagrams, Very long pulses, Operational degradation factor, Active displays, Unified detection and classification, Bandwidth, Beamwidth, CADAC, Levels of CADAC, CADAC and pulse features, Statistical analysis, Amplitude profiles, Multipath affects classification
Textbook:
References:
2. Understanding Active Noise Control C.H. Hansen
3. Underwater Acoustic Systems Rodney F.W. Coates
4. Underwater acoustics Leon Camp

VII. SHIP CONSTRUCTION

Periods/week : 4                                                                     Ses. : 30 Exam : 70
Examination Theory: 3hrs.                                                              Credits: 3

Course Objective:
• To be well versed in how to apply various knowledge of architecture on ship operations.
• To Understand Ship Stability and Statically Stability

Course Outcome:

- CO 01: To understand the types of Ships
- CO 02: To understand the Stress and Strain in Ships in Still water and in Sea way
- CO 03: To understand the principle part of Ships
- CO 04: To understand the advantages of welding over riveting
- CO 05: To understand the concept of law of floatation
- CO 06: To understand the center of buoyancy and factors affecting the same
- CO 07: To understand the Transverse Statically stability
- CO 08: To understand the Equilibrium of Ship
- CO 09: To calculate of List while Loading, Discharging and/or shifting weights, Correction of List
- CO 10: To understand how to use of hydrostatic tables and curves as supplied to ships, Displacement/draft-curve and table, Light displacement& Load displacement

SYLLABUS

Introduction to ship building and materials used:


Joining methods of materials, non-destructive testing.

Storage and preparation of material and structural elements:

Material handling and storage, transport system in steel stockyard, material preparation Devices- cleaning, marking processes. The cutting process, Mechanical cutting, thermal Cutting, optically and numerically controlled cutting, bending of rolled and built-up sections, Plate bending. Nesting of plates.

Fabrication of sub-assemblies, units and hull erection:

Process of prefabrication, welding in prefabrication and erection stages, sub-assemblies, flat Sections, panels- flat and curved, double bottom sections, side tank units, fore-end and aftend Structures, deck and bulkhead structures. Assembly of hull-units. Erection of hull-units

On building berth/dock.
Ship structural components:
Functions and details of ship structural components, framing systems, single and double
Bottom construction, shell and deck plating, bulkheads, pillars, girders and hatch-coaming,
Machinery casings, super structures and deck- houses. Bow and stern Structures. Bossing and
Struts, bilge keels and fenders.

Out Fitting, Welding, Testing And Trials And Launching:
Various components of outfitting, consisting of systems, equipment and fittings of hull,
Machinery and electrical groups. Hull Preservation methods. Various outfitting methods.
Advanced outfitting. Methods of welding, metallurgy of welding weld defects, distortion and
Stresses in welds, testing of welds. Inspection and testing during various stages of ship
Construction. Testing of structures and tanks. Bollard tests and sea trials. Details of launching
Arrangements.

References:
1. Merchant Ship Construction by D. A. Taylor
2. Ship Construction by D.J. Eyres
3. Ship Design and Construction by R. Taggart

VIII EXPERIMENTAL HYDRODYNAMICS
Periods/week: 4      Ses.: 30      Exam: 70

113
Course Objectives: To provide students with a sufficient introduction to each of the topics of the course so that he/she will be able to understand the background of current literature in the hydrodynamics of marine vehicles, offshore engineering, and other ocean-related activities.

Course Outcomes: Students with ocean- and marine-related interest will develop the necessary theoretical and experimental background to keep up with existing literature and begin research on contemporary topics.

SYLLABUS

Small Amplitude Wave Theory Formulation and Solution: Review of hydrodynamics-Boundary Value Problems, summary of two-dimensional periodic water wave BVP, solution of linearized water wave BVP for a horizontal bottom, dispersion equation, engineering wave properties-water particle, kinematics of progressive waves, pressure field under a standard wave, partial standing waves, energy and energy propagation in progressive waves- principle of conservation of energy. Energy Flux.

Wave Forecasting: Generation of waves-theories of wave generation by Kelvin, Phillips, Milne, Jeffrey, Swerdru and munk. Concept of fully developed sea, Characteristics of ocean waves, significant wave height and period, wave height variability, energy spectra of waves, simplified wave prediction models-SMB and PNJ. Methods, wave forecasting charts, effects of moving storms and variable wind speed and direction.

Wave Transformation and Wave statistics: Transformation of wave entering shallow water, shoaling of waves in shallow water, wave reflection, refraction and diffraction, combined refraction, diffraction, and wave breaking. Wave Height distribution-single wave train, wave groups, narrow banded spectra, Rayleigh’s distribution, wave spectrum, directional wave spectrum-JONSWAP, PNJ and Bretschneider spectra.

Wave Forces: Wave forces on vertical cylindrical bodies due to non-breaking waves – Basic concepts, calculations of forces and moments, Transverse forces due to eddy shedding (Lift forces), selection of hydrodynamic force coefficient, $C_d$ and $C_m$, calculation of forces and moments on groups of vertical and non-vertical cylindrical bodies due to breaking and non-breaking waves.

Text Book:

Reference Books:
1. Water Wave Mechanics by Dean and Dlrymple
2. An introduction to Hydrodynamics and Water Waves by B. Le Mehaute
3. Estuary and Coastline Hydrodynamics by A.T. Ippen
IX. MARINE POWER PLANT ENGINEERING

Periods/week: 4  Ses.: 30  Exam: 70

Examination Theory: 3hrs.  Credits: 3

SYLLABUS


Marine boilers: Marine Boilers of Fire Tube, Composite and water-tube boilers. Feed water treatment. Feed water supply systems and controls.

Marine steam turbines: Construction details, Compounded steam turbines for Marine applications, Operation and maintenance.


Nuclear power plants: Nuclear fission reaction, types of reactors, Fuels, moderators, Coolants, Control and safety rods, radiation hazards and shielding, Radioisotope applications, Radioactive Waste disposal, Nuclear Powered propulsion, Indian reactor developments.

Marine Refrigeration and Air Conditioning: Marine refrigeration systems- operation and maintenance-application in modern passenger ships, bulk carriers and refrigerated vessels. Air conditioning systems on board the ships-temperature and humidity control-comfort conditioning. Cabin and cargo ventilation- piping and ducting-insulating materials

Text books:

1) Marine Power Plants -- P.Akinov
2) Nuclear Engineering -- D.K.Singhal
3) Marine Engineering -- R.Harrington
4) Introduction to Marine Engineering -- D.A.Taylor
XI. MARINE ENGINEERING-I

Periods/week: 4  
Ses. : 30  
Exam : 70  

Examination Theory: 3hrs.  
Credits: 3

SYLLABUS


Marine Turbines – Steam turbine Classification based on impulse and reaction principles – Flow thro’ blade passages and design – Losses and performance – Compounding, velocity triangles – Starting and Maintenance procedures.

Marine gas turbines – Practical cycles and shaft arrangements - Power turbine – Applications.


Ventilation – Requirements and provision – Insulation protection of materials and maintenance.


Text Books:

2. Marine I.C Engines-A.B Kane
3. Principles and practice of Marine Diesel Engines – D.K Sanyal
5. Marine Steam Boilers- Milton J.H.
XII HYDRO DYNAMICS AND COMPUTATIONAL METHODS

Periods/week: 4

Ses. : 30

Exam : 70

Examination Theory: 3hrs.

Credits: 3

SYLLABUS

Introduction and Basic Numerical Methods: Introduction to CFD, Approximation and interpolation, Numerical integration, Finite difference approximations of derivatives


Modeling Navier Stokes Equations: Governing equations for fluid mechanics, Staggered grids, Pressure-velocity coupling – the SIMPLE algorithm, Steady flows, Unsteady flows, Implementation of boundary conditions Commercial CFD codes, Reynolds averaged Navier-Stokes (RANS) equations and turbulence modeling

Text Books: 1. Introduction to CFD the finite volume method by Malalasekera & Versfeeg 2. Computational FM and heat transfer by Anderson, Tennehill and Pletchen
HSS ELECTIVES
ORGANIZATIONAL BEHAVIOUR

Course Objectives:
1. To understand the basic concepts of organisational behaviour, its foundations and importance.
2. To enable students to have a basic perspective of Motivation and Motivation theories.
3. To acquaint the students about group behaviour in organizations, including communication, leadership conflicts and organizational change and how these are linked to and impact organizational performance.

Course Outcomes:
1. Identifying fundamental aspects of organizational dynamics.
2. Evaluate main theories of motivation and formulating suitable motivational strategies.
3. Analyze the behaviour of individuals and groups in organizations.
4. Understanding of Leadership theories and Leadership behaviour.
5. Apply relevant theories, concepts to address important Organizational Behaviour questions.

Syllabus


Motivation: Definition - Nature of Motivation - Role of Motivation - Theories of Motivation : Maslow's Need Hierarchy Theory, Herzberg’s Motivation Hygiene Theory and McClelland's Theory X and Theory Y.

Group Dynamics: Meaning - Concept of Group - Types of groups - Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non-Verbal communication - Direction of communication : Downward, Upward and Horizontal communication.


Text Books.
1. L.M. Prasad: Organisational Behaviour, Sultan Chand & Sons, New Delhi - 110002

Reference Books.

INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives:
1. To familiarize the students with the concepts of Management.
2. To relate the concepts of Management with industrial organizations.
3. To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.
4. To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:
On completion of the course, the students will be able to:
1. Understand the roles, skills and functions of management.
2. Distinguish the different types of business organizations.
3. Identify the factors involved in Production Operations Management.
4. Diagnose organizational problems and take suitable decisions.
6. Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

Syllabus

Basic Concepts of Management:
Management :- Definition, Nature and Importance; Functions of the Management; Levels of Management; F.W. Taylor's Scientific Management; Henry Fayol's Principles of Management;

Forms of Business Organizations: Introduction, Types of Business organizations: Private Sector - Individual Ownership, Partnership, Joint stock companies and Co-operative organizations; Public sector - Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Production and operations Management: Plant location - Factors to be considered in the selection of Plant location; Break - even analysis - Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.


Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques, Stages in Project formulation, Steps for starting a
small enterprise - Incentives for Small Scale Industries by Government.

Text Books:

Reference Books:

OPERATIONS RESEARCH

Course Objectives:
- Formulate a real world problem as a mathematical programming model.
- Provide knowledge of optimization techniques and approaches.
- Understand and study inventory problems.
- Know the network models.
- Put on knowledge in solving replacement problems and different queueing models.

Course Outcomes:
- Learned to translate a real-world problem into a mathematical formulation.
- Formulate and Solve Transportation, Assignment and sequencing problems.
- Resolve inventory problems.
- Able to solve maximum flow and shortest path problems.
- Capable to solve replacement problems and analyze queueing models.

SYLLABUS


Allocation: Linear Programming problem formulation; Basic assumptions; Graphical solution; Simplex method; Artificial variable technique; Two phase method; Big M method; Duality principle; Primal and Dual relation.

Transportation: Formulation; Solution methods; Unbalanced transportation problems - North west corner rule; Least cost entry method; Vogel’s approximation method; Optimal solution; degeneracy.

Assignment: Formulation; Variations in Assignment problem; Travelling salesman problem.

Sequencing: Sequencing of - n jobs through two machines; n jobs through three machines; n jobs through m machines; 2 jobs through m machines.
Inventory Control: Introduction; Types of Inventory; Inventory costs; Deterministic models - Economic order quantity (EOQ) and Economic Production Quantity (EPQ) with and without shortages; Quantity discounts; P system; Q system; Inventory control Techniques.

Network Analysis: Network definitions; Time estimates in network analysis; Labeling using Fullkerson’s rule; Forward pass computations; Backward pass computations; Project management using Critical Path Method(CPM) and Programme Evaluation and Review Technique(PERT).

Replacement: Introduction, Replacement of items that deteriorate with time - Value of money unchanging and changing, Replacement of items that fail completely.

Queueing models: Introduction; Single channel poisson arrivals; Exponential service times; Unrestricted queue with infinite population and finite population models; Multi channel poisson arrivals; Exponential service times with infinite population and restricted queue.

Text Books:

Reference Books:
1. R. Pannerselvam, "Operations Research", PHL.
4. V.K. Kapoor, "Operations Research" Sultan Chand & Sons