### SCHEME OF INSTRUCTION & SCHEME OF EXAMINATIONS
#### M.Tech. DEGREE PROGRAMME IN NAVAL ARCHITECTURE AND MARINE ENGG.
2 Years evening course

### I Semester

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Course</th>
<th>Periods</th>
<th>Exam Hours</th>
<th>Sessional Marks</th>
<th>Exam Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME1.1</td>
<td>Basic Naval Architecture</td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME1.2</td>
<td>Ship Design &amp; drawing</td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME1.3</td>
<td>Ship Construction and Outfitting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAME1.4</td>
<td>Experimental Hydrodynamics</td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME1.5</td>
<td>Elective I:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1)Powering of Ships</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2) Marine Machinery and Marine Engines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Wave Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME1.6</td>
<td>Elective - II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Marine Instrumentation &amp; Stress Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Advanced FEA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Elements of Ship Vibrations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME 1.7</td>
<td>CFD Lab</td>
<td>3</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>NAME1.8</td>
<td>Seminars</td>
<td>3</td>
<td>---</td>
<td></td>
<td></td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### II Semester

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Course</th>
<th>Periods</th>
<th>Exam Hours</th>
<th>Sessional Marks</th>
<th>Exam Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME2.1</td>
<td>Sea Keeping and Maneuvering</td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME2.2</td>
<td>Hydrodynamics &amp; Computational Methods</td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME2.3</td>
<td>Advanced Marine Vehicles</td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME2.4</td>
<td>CAD / CAM in Marine Design and Construction</td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME2.5</td>
<td>Elective - III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced Marine Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Industrial Engg and Mgt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub Sea piping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME2.6</td>
<td>Elective - IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marine Power Plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced Fluid Mechanics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fishing Vessel Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>NAME2.7</td>
<td>CASD Lab</td>
<td>3</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>NAME2.8</td>
<td>Seminars</td>
<td>3</td>
<td>---</td>
<td></td>
<td></td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### III Semester

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Scheme of Examination</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME 3.1</td>
<td>Dissertation (Preliminary)</td>
<td>Viva-Voce</td>
<td>100</td>
<td>12</td>
</tr>
</tbody>
</table>

### IV Semester

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Scheme of Examination</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME 4.1</td>
<td>Dissertation (Final)</td>
<td>Viva-Voce</td>
<td>100</td>
<td>12</td>
</tr>
</tbody>
</table>

Grades for Dissertation (Preliminary and final) Viva Voce are A,B,C and F (A= excellent; B= Very good; C= Good F= not accepted.)

Dissertation Preview Viva-Voce Examination will be conducted with a committee consisting of Head of the Department, Chairman BOS and Guide.

Dissertation Final Viva-Voce Examination will be conducted with a committee consisting of Chairman, Board of Studies, Head of the Department, Internal Guide, External Guide (Approved by the University Administration).
Semester – I

NAME1.1 Basic Naval Architecture
Examination: 70  
Sessionals : 30  
Periods per week : 4  
04 credits

Ship geometry & form co-efficient, Hydrostatics, Intact and damaged stability, Free surface effects, Subdivision & floodable length, IMO stability criteria, Launching calculations, Stability of submerged bodies

NAME1.2 Ship Design & Drawing
Examination: 70  
Sessionals : 30  
Periods per week : 4  
04 credits

Types of ships, size, Principal particulars and ranges of form parameter and ratios, Basic hull form generations and lines plan, offset tables, Ship design procedures, Design spiral, General arrangement, Scantling calculations, Mid hip section, Weight estimations, Deadweight, capacity and tonnage, Trim & Stability Booklets, Powering, Class notations, Safety and Classification Society Rules. Ship Drawing.

The Strength and structure of ships: Forces acting on ship structures, Ship strength and beam theory, Beam and load classification, Longitudinal bending of ship structures: Shear force and bending moment diagrams, section modulus and mid ship section. Structural stresses within a ship: hull girder stresses, local stresses, means of determining ships strength curves, Scantlings of ship structures, Structural analysis.

NAME 1.3 Ship Construction and Outfitting
Examination: 70  
Sessionals : 30  
Periods per week : 4  
credits -04

Brief on the major shipyards and ship building activities in the country, Ship building technology and practices, Construction of ship's hull and it's structural components: Bottom structure, shell plating, Decks, Bulkheads, Framing system etc., Structural alignment and continuity, Ship building steel, Steel material preparation (shot blasting etc.), Lofting, Plate nesting and cutting methods, Plate and section forming techniques, Welding principles, Types of welding and methods, Causes of welding distortions and preventions, Welding defects, Weld inspection methods

NAME 1.4 Experimental Hydrodynamics
Examination: 70  
Sessionals : 30  
Periods per week : 4  
04 credits

Requirement of ship model experiments, ITTC and it's role, Hydrodynamic test facilities, Dynamometry and instrumentation in model testing, Methodical series data, Statistical/empirical method of resistance and powering estimation, Experimental techniques and methods for full scale predictions, Resistance, open water and propulsion experiments, Wake survey, Analysis of results, Cavitation experiments, Full scale sea trials.

N.B. The above course will mostly practical and tutorial oriented

NAME1.5 Elective - I
(1) Powering of Ships
Examination: 70  
Sessionals : 30  
Periods per week : 4  
04 credits

Components of ship resistance, Dimensional analysis, Froude’s hypothesis and his experiments, Viscous resistance, Friction lines, Wave resistance, Kelvin wave pattern, Form resistance, Appendage drag, Computation of ship powering, Wake fraction, Thrust deduction, Propulsive efficiency, Model-ship extrapolation and correlations, Trial allowances, Resistance of submerged bodies

History and development of screw propellers, Types of propellers, Propeller geometry / drawings, Propeller action -momentum theory, Propeller coefficients, B-Series data, Interaction between hull and propeller, Cavitation, Types of cavitation, nature and causes, Strength of propellers
NAME1.5 Elective - I

(2) Marine Machinery & Marine Engines

Examination: 70
Sessionals: 30
Periods per week: 4
04 credits

Details of pumps for marine purposes - Ejectors and their purpose. Applications in Marine use. Details of construction. Various types of piping systems fitted in ships, expansion arrangements for pipes, valves and fittings. Types used in marine practice, materials and corrosion in pipes, color codes for different pipes. Evaporators, distillers, waste heat recovery systems. Hot water, drinking water, cooling water (fresh water) and sea water systems. Fuel systems, lubricating oil systems, strainers and filters, coolers, centrifuges, purifiers and clarifiers. Bilge and Ballast systems - sewage’s disposal system.

Cargo handling - dry cargo handling equipment - winches, cranes, cargo gears, Pontoon hatch covers, liquid cargo handling in tankers, cargo pipe layout systems - loading, unloading, ventilation, cleaning.

Steering gears: Different types - description of construction, operation and maintenance.

Docking methods: Docking methods for ships - Inspection and routine overhauling of under water fittings and hull.

Stern Tubes: Stern tubes and glands - oil lubricated stern tubes, shaft seals, shaft alignment, thrust block, reduction gearing.

Safety systems: Safe working practices, precautions in overhauling machinery parts, mechanical safety in workshops, protective equipment.


Marine Diesel Engines, Basic theory, Fuels, lubrication and cooling, Scavenging and supercharging, Starting, reversing and automation, maintenance. Medium speed engines and auxiliary engines.

NAME1.5 Elective - I

(3) Wave Engineering


Text Books:

References:
NAME1.6 Elective -II
(1) Marine Instrumentation & Stress Analysis

Periods/week : 4  
Exam : 70

C redits : 4

Sessionals : 30 Marks

4. Stain gauges – Photo elastic, Electrical, resistance gauges, cements and cementing of Gauges – Bridge circuits – balanced and unbalanced, Calibration gauge rosettes – Evaluation of Principal stresses – Static and dynamic gauges for various applications.
5. Stress analysis – Whole field techniques by photo elasticity, brittle coatings, Grid methods & Moire – Applications to the solution of engineering problems.

Text Books:
3. Experimental methods for engineers. - J.P Holman

NAME1.6 Elective -II
(2) Advanced Finite Element Analysis

Periods/week : 4  
Exam : 70

C redits : 4

Sessionals : 30 Marks

1. Overview of finite element method, Discretization of the domain, Interpolation models, Higher order and isoparametric elements, Derivation of element matrices and vectors, Assembly of element matrices and vectors and derivation of system equations, Numerical solution of finite element equations, Analysis of trusses, beams, and frames
2. Analysis of plates and Shells
3. Three-dimensional problems
4. Vibration Analysis - Modal and Harmonic analysis
5. Fluid flow problems - Basic equations of fluid mechanics, Inviscid and incompressible flows

Textbook
2. Finite Element Modeling for Stress Analysis - R D Cook - John Wiley
**NAME1.6  Elective-II**

(3) Elements of Ship Vibrations

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


5. Ship vibration: Introduction to ship hull vibration-- Mathematical basis of ship vibration - calculation of ship hull vibration

**Text books:**

1. Ship Hull Vibrations: Todd
2. Mechanical vibrations, Schaum's outline series- William W. Seto

---

**NAME 1.7 CFD Lab**

**Periods/week**: 3  
**Ses**: 50  
**Exam**: 50  
**Examination Theory**: 3hrs.  
**Credits**: 2

1. Exposure to CFD packages like Star-CCM+, Ansys
2. Geometry creation of simple 2-D and 3-D Objects
3. Mesh Generation
4. Boundary conditions
5. Solution for varying parameters like Reynolds Numbers, Froude Number etc
6. Application to Ship Drag calculation (pressure and Friction)
7. Presentation of results of ship drag compared with IITC values

---

**NAME 1.8  Seminars**

Each student has to present at least 4 seminars on a topic that is approved by the concerned teacher. The final seminar should be presented before a committee constituted by the Head of the Department
### Semester - II

**NAME 2.1 Sea keeping and Maneuvering**

Examination: 70  
Sessionals : 30  
Periods per week : 4  
04 credits

Ship motions in a sea way : Ocean waves, Theory of simple gravity waves, Trochoidal Waves, Regular and irregular waves, Statistical representation of ocean wave patterns, Translational and rotational components of ship motions, Coupled motions, Effects of ship motions

Ship maneuvering and control : Path keeping and definitions of motion stability, Equations of motion, notations, Control fixed stability indices and stability criteria, Stability and control in horizontal and vertical planes, Standard maneuvers and evaluation of maneuverability and control characteristics

**NAME 2.2 Hydrodynamics & Computational Methods**

Examination: 70  
Sessionals : 30  
Periods per week : 4  
04 credits


**NAME 2.3 Advanced Marine Vehicles**

Examination: 70  
Sessionals : 30  
Periods per week : 4  
04 credits

Classification of high speed crafts and types, comparison based on hydrodynamic performance, Structural design considerations, propulsors for high speed crafts.  
Design features and powering characteristics of Semi-displacement crafts, Planing crafts, Hydrofoils, Air cushion vehicles, Surface effect ships, Wing-in-ground crafts.  
Introduction to multi-hull ships : Catamaran, Trimaran, Pentamaran  
Latest types of advanced marine crafts.

**NAME 2.4 CAD/CAM in Marine Design and Production**

Examination: 70  
Sessionals : 30  
Periods per week : 4  
04 credits

Introduction to CAD/CAM, Commercial software for 3-D modeling and analysis, areas of application, Computer graphics, Geometrical modeling, Wire frame and solid models, 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.
(1) Advanced Marine Engineering

Periods per week: 4  
Credits: 4  
Examination: 70 Marks  
Sessionals: 30 Marks


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.

(2) Industrial Engineering and Management

Periods per week: 4  
Credits: 4  
Examination: 70 Marks  
Sessionals: 30 Marks

2. Facilities location and Layout: Factors for selection of a location, Urban, Suburban and rural locations, Types of layouts, process and product layouts, Line balancing, Shipyards and port layouts.
3. Material Handling: Principles of material handling, Types of material handling equipment, Selection of material handling equipment.
4. Inventory control: Costs of inventory, ABC Analysis, Economic order quantity, Economic lot-size quantity, Basic inventory models.
5. Quality Control: Quality and product design, Control charts.
6. Network analysis: Network techniques of program management, CPM and its advantages, Difference in PERT & CPM, steps in CPM technique, Steps in the technique of PERT planning, Estimation of activity duration. Float or slack, Latest finish time, resource leveling program, crash of the project.
Text Books:
1. Industrial engineering and management - O.P Khanna

References:

NAME 2.5 Elective – III
(3) Subsea Piping

1. **Introduction**: Material properties, pipe production, pipe fabrication, specifications, Methods of increasing corrosion resistance, CR alloys and their manufacturing, Evaluating corrosion resistance and external protection, Welding of pipelines, welding sequence, Manual, semiautomatic and automatic welding

2. **Flexible and Composite Pipelines**: Introduction, Fabrication techniques, Internal and external corrosion, sour service, Failure modes of flexible pipes, Composite pipelines


4. **External Corrosion and pipeline hydraulics**: External corrosion and coatings, Cathodic protection, concrete weight coatings, thermal insulation, Single-phase flow Newtonian fluids, heat transfer and flow temperature, hydrates, multiphase flow

5. **Strength and stability**: Introduction, Design to resist Internal and external pressures, Longitudinal stress, Bending, Indentation, and Impact, Design currents and waves, Hydrodynamic forces, lateral resistance, Stability design

6. **Marine pipeline construction and Shore approaches**: Lay-Barge construction, reel construction, pull and tow, trenching, coastal Environment, site Investigation, horizontal drilling, Tunnels and tidal flat

Reference: Palmer, Andrew C.(Andrew Clennel), 1938-Subsea Pipeline engineering, / Andrew C. Palmer and Roger A

NAME 2.6 Elective – IV
(1) Marine Power Plant


5. 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.


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.
**NAME 2.6 Elective – IV**

(2) Advanced Fluid Mechanics

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

**Basics**
- Methods of Describing Fluid Motion
- Kinematics of Fluid Motion -- the Eulerian picture
- Kinematic transport theorem
- Forces in the Fluid
- Law of Momentum Conservation
- Relations between stress and rate-of-strain tensors
- Vorticity Theorem for a viscous fluid
- Rayleigh's Problem -- solid wall as a source of vorticity
- Scaling and similarity parameters

**Low Viscous Flows**
- A thin fluid layer flowing down an incline
- Lubrication approximation for flow in a thin layer
- Stokes flow past a sphere
- Oseen's improvement for slow flow past a cylinder

**High-Speed Flows and Boundary Layers**
- Flow of inviscid and homogeneous fluids
- Viscous Flow at High Reynolds Numbers
- Two dimensional laminar jet
- The effects of pressure gradient
- Karman's momentum integral approach
- Unsteady boundary layers

**Rudiments of Hydrodynamic Instability**
- Rudiments of Hydrodynamic Instability
- Kelvin-Helmholtz Instability for continuous shear and stratification
- Inviscid Instability mechanism of parallel flows
- Viscous Effects on the Instability of parallel flows

**Textbooks:**
- Viscous Fluid Flow - White, John Wiley
- Boundary Layer Theory - Schlichting

**NAME 2.6 Elective – II**

(3) Fishing Vessel Technology

- **Periods/week:** 4
- **Ses.:** 30
- **Exam:** 70
- **Credits:** 4

**Importance of fishing,** Classification of fish for harvesting.
**Fishing methods:** Purse seining, Drift netting, Gillnet fishing, Long line fishing, Pole and line fishing, Trawling, Harpooning.

**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.

*Design of fishing vessels.* Side trawlers, stern trawlers, purse seining. General arrangement, Layout and equipment on deck.
Machinery- main and auxiliary, Electrical systems, structural arrangements. Materials for the construction of fishing vessels.

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:**
1. Design of Small Fishing Vessels by John Fyson
2. Fishing Boats of the World by Jan-Olof Traung
NAME2.7  
Computer Aided Ship Design Lab  

Periods/week: 3 Ses : 50 Exam: 50
Examination Theory: 3hrs. Credits: 2

1. **Ship Structural Analysis using FEA Packages**: Modelling, Meshing and solving using FEM packages. Automatic mesh generation- presentation of results - 3-dimensional shape description and mesh generation- Application of FEA packages in the analysis of ship components.

2. **CASD (Computer Aided Ship Design)**

3. Exposure to CASD packages like Rhino, NAPA, TRIBON, Shipflow etc:

4. **Generation of ship hull parametric model using Modelling Softwares**