### B.E IV/IV SEMESTER - I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>COURSE</th>
<th>Periods (L/T/Lab)</th>
<th>Exam (hours)</th>
<th>Sessional Marks</th>
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<td>Sea Keeping and Maneuverability</td>
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### B.E IV/IV SEMESTER - II

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<th>Sessional Marks</th>
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# For other department students
*Taught by Humanities Department


3. **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.


5. **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
1. Introduction, Historical review: The structure of wooden ships. Transition from wood to steel. The structure of riveted ships and welded ships. Riveting and welding in ship building. Structural changes from riveted to welded ships. General mid-ship section structural arrangements for different types of ships-general cargo ship, oil tanker-single and double hull, bulk carrier, container ship, tug, trawler, passenger ship, cross channel ferry.

2. Structural parts and functions and classification rules: Different structural elements- keel, transverse frames, longitudinal frames, web frames, vertical keelson, beams, girders, floors, brackets, pillars, stem bars, stern frames, bulkhead stiffeners, platings etc.-their structural configuration, design features and functional aspects. Assembly of various structural elements into the structural parts of the ship such as double bottom structure, side shell, single bottom structure, bulk head structure, deck structure, aft-end structure, fore-end structure, super structure etc. Structural design as per classification society rules. Use of relevant standards in structural design.

3. Structural Design of Bottom, Side Shell, Bulkhead, deck, fore-end, aft-end structures: Bottom structures, structural design of single bottom and double bottom structures, their structural configuration and determination of dimensions and scantlings of stiffeners, frames, longitudinal, inner and outer bottom plating, Shell plating and framing-layout of strakes, spacing of framing, shell expansion plan, longitudinal and transverse frames, ordinary and web frames, end connections of frames, Bulk heads-structural arrangement of bulk heads, longitudinal and transverse bulk heads, determination of scantlings and sizes of structural parts of bulkheads, plating and stiffening of bulk heads, in flat, corrugated, Swaged and non-water tight bulk heads, connection of bulkheads with side shell, decks etc., partial bulk heads.

        Decks - deck plating, subdivision of strakes and structural arrangements of longitudinal and transverse stiffeners. Determination of scantling, end-connections of deck stiffeners. Fore-end structure-stem profiles, plating and stiffening of the fore end structures, panting arrangement, stem design-built up or cast, bulbous bow construction, details of arrangements, chain locker, hawse pipes, paint stores, forward collision bulkheads, determination of scantlings.

        Aft-End structure-stern profiles, plating and stiffening of aft-end structure, stern frame - built up or cast, details of stern tube, bossings, shaft struts etc. Different types of rudder configurations and stern fittings for these rudder types. Nozzles and propeller arrangements. Determination of structural scantlings.

turbines, boilers, auxiliary machinery. Static and dynamic loads in engine room. Structural design of engine room and determination of scantlings.


Propeller exciting forces. Damping – Types of damping. Special local vibration problems – Rudder vibration, cavitation, stress and vibration levels, human reaction to vibration.


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
NAM 413 - ELECTIVE –III
(A) FISHING VESSELS TECHNOLOGY
Periods/week : 5  Ses. : 30  Exam : 70
Examination Theory: 3hrs.  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, Mid water trawling, Purse seining Fishing nets – Operation, Parts of Fishing net and functions.
Storing and preservation of fish on board a vessel, Fish hold arrangement. Insulation, icing and freezing.
Refrigeration machinery.
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

NAM 413 - ELECTIVE –III
(B) DESIGN OF SMALL CRAFTS
Periods/week : 5  Ses. : 30  Exam : 70
Examination Theory: 3hrs.  Credits: 4

1. 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.
3. 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
2. Tugs, Towboats and Towing by Edward M. Brady

NAM 413 - ELECTIVE –III
(C)NAVAL VESSELS

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

1. **Historical development of different types of naval vessels:** Distinguishing features of warship types. Indigenous design and production of naval vessels. Mission requirements and constraints. Concept exploration and development of warship criteria. Determination of main dimensions. Volumes based and weight based criteria. Space allocation and general arrangement.


3. **Main and auxiliary machinery in warships:** Comparative methods of steam, diesel and gas turbine plants. Combined plants. Requirements of sea keeping and stability platform. Stabilisation systems. Special manoeuvring requirements for naval vessels.


NAM 413 - ELECTIVE –III
(D) ADVANCED WELDING TECHNOLOGY

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

1. **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.

2. **Plastic Welding:** Forge Welding: Types, Forged joints etc. Resistance Welding: Principle, types, spot, seam, etc. Thermit welding.

3. **Gas Welding:** Principle, equipment, different gas flames, gas welding techniques, types of gas welding, oxy-acetylene, air-acetylene, and oxy-hydrogen welding etc.
4. 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.

5. 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.

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

Textbooks:
1. Welding Engineering by R.L. Agrawal and Tahil Manghnani
3. Welding Technology by N.K. Srinivasan

References:
1. Welding Engineering and Technology by R.S. Parmar
2. Welding and Welding Technology by Richard L. Little
3. Welding by A.C. Davies
4. Production Technology by R.K. Jain and S.C. Gupta
6. Welder Trade Theory by S.K. Singh

NAM 414 - MARINE MACHINERY – II

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

1. Steering gears: Different types-description of construction, operation and maintenance.
2. Docking methods: Docking methods for ships-Inspection and routine overhauling of under water fittings and hull.
Safety systems: Safe working practices, precautions in overhauling machinery parts, mechanical safety in workshops, protective equipment.
Precautions against fire or explosion. Machinery and boiler casualties. Explosive mixtures and substances, dangers of oil leakages, sources of ignition safety devices toxic and other dangerous properties of substances as marine cargo. Carrying dangerous goods.

Scavenge fires, and crank case explosion, oil mist detectors.

References:
1. Marine Engineering by R.Harrington
2. Marine Auxiliary Machinery by D.W. Smith and Sonchotte
3. Reed’s General Engineering Knowledge for Marine Engineers.
4. Material Handling by N.Rudenko
5. Principles of Naval Architecture by J.P. Comstock
6. Principles and Practice of Marine Diesel Engines D.K.Sanyal

NAM 415 – ELECTIVE – IV
(A) MARINE DIESEL ENGINES

Periods/week : 5
Examination theory: 3hrs. Credit: 4
Ses. : 30 Exam : 70

1. Basic theory: Actual cycles, power rating and engine testing, test code

2. Fuels, lubrication and cooling: Fuel properties, Heavy oil burning, fuel oil systems, Lubricant oil properties, Lubricating oil systems, Lubricating oil contamination and purification, cooling systems—Fresh water and sea water, piston cooling.

3. Scavenging and supercharging: Types of scavenging, scavenging parameters, Super charging, Pulse and constant pressure Supercharging, exhaust grouping.

4. Engine components: Crank shaft alignment and failure, piston and cylinder liner, Diesel Engine bearings.
5. **Starting, reversing and automation:** Starting systems, Compressor air starting, Reversing methods for 2-stroke and 4-stroke engines, controls and automation.

6. **Hazards and maintenance:** Scavenge fire, Crankcase explosion, oil mist detector, Overhaul and maintenance of Marine Diesel Engines.

7. **Medium speed engines and auxiliary engines:** Uses and advantages of medium speed engines, Power transmission to Propellers, use of auxiliary engines.

**Text book:**

**Reference Books:**
1) Internal Combustion Engines -- P.L. Ballaney
2) Internal Combustion Engines - Theory & Practice -- S.P. Sen

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**NAM 415 – ELECTIVE – IV**

(B) UNDERWATER ACOUSTICS

Periods/week : 5  
Ses. : 30  
Exam : 70  
Credits: 4

**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, Beamformers, 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 f-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,

Activesonar
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, Full- and 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

References:
2. Understanding Active Noise Control C.H. Hansen
3. Underwater Acoustic Systems Rodney F.W. Coates
4. Underwater acoustics Leon Camp

NAM 415 – ELECTIVE –IV
(C) MARINE POLLUTION

Pollution of ocean environment – discharges from ships and offshore platforms - air, oil sewage and garbage; pollution of coastal waters – discharges from industries, riverine discharge and dredging; pollution of port waters – ballast water, ship’s discharge, cargo discharge (oil and ore); Environmental problems due to maritime construction on near shore areas, dismantling of maritime structures and ships; occupational health and hazards.
IMO and regulatory mechanism to check pollution; quality systems for environmental control; environment manoeuvring, alternative methods of technology, education and training

References:
1) Marine Pollution, By Chris Frid, Martin Attrill and Robert Clark., Oxford University Press.
NAM 416 - SHIP DRAWING –III

Ses. : 100  
Credits: 4

1. Launching calculations and plotting of curves, determination of various launching parameters.  
**Practical:** Launching calculations.

2. General arrangement drawings, delineation of decks and compartments, building drawings as fitted drawings, layout drawing, system drawings.  
**Practical:** Layout of accommodation spaces and accesses. Layout of any system. Layout of various compartments/engine room/ tanks.

**Practical:** Hull vibration calculations.

References:
1. Resistance and Propulsion of Ships by S.A.Harvald
2. Ship Design and Construction by R.Taggart

NAM 417 - SHIP HYDRODYNAMICS LABORATORY

Periods/week : 3  
Ses. : 50  
Exam : 50  
Credits: 2

**15 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.

NAM 418 - PROJECT

Periods/week : 6  
Ses. : 50  
Exam : 50  
Credits: 2

The student has to chose a project with an internal guide, start the work and continue in 4th year second semester.
Seminar followed by Viva-Voce Examination will be conducted to the completed portion of the project at the end of 1st semester by a committee consisting of the Head of the Department and Guide.

NAM 419- INDUSTRIAL TRAINING REPORT

Ses: 100  
Credits: 2

The student has to prepare and submit a comprehensive report about the practical training undergone detailing the knowledge, skills and orientation acquired during the period in any specified industry/organization.

A seminar at least 20 minutes duration is to be given, subject to evaluation by Departmental faculty with Head of Department as Chairman.
1. **Instrumentation:** Concepts of measurements, static performance, characteristics accuracy of measurement and its analysis. Instrumentation, for measurement: Force, torque, strain, pressure, flow, temperature and vibration.

2. **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.

3. **Introduction:** Control systems, Feedback and its effects. Transfer Function, Block Diagram and Signal Flow Graph: Impulse response and Transfer functions of linear systems, Block diagrams.


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

**References:**

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**NAM 422 – COMPUTER AIDED SHIP DESIGN**

Periods/week : 5  
Ses. : 30  
Exam : 70  
Credits: 4

1. **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.

3. 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.

4. 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.

# FE 02- FREE ELECTIVE II
COMPUTER AIDED DESIGN

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


3. 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.

4. CAD applications and exposure to CAD packages: Simple examples of computer aided drafting, design and analysis - Introduction to simple machine elements - Analysis of cross sectional area, centroid & moment of inertia- Kinematics of crank- slider mechanism and other simple design applications. Introduction to CAD packages like ANSYS, NASTRON, NISA-II.

5. Introduction to Artificial Intelligence Introduction to Artificial Intelligence - Applications of AI in design and CAD.

Text Books:

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

2. **Conditions of Different market Structures** – Perfect Competitions, Monopolistic Competition, Monopoly, Oligopoly and Duopoly.

3. **Forms of business organizations** – Sole Proprietorship, Partnership, Joint Stock Company- Private limited and public limited companies, public enterprises and their types.


5. **Production Management** – Production Planning and Control, Plant Location, Break – Even Analysis, assumptions and applications.


7. **Entrepreneurship** – Entrepreneurial Functions, Entrepreneurial Development; Objectives, Training, Benefits; phases of Installing a Project.

**Text Books:**

1. K.D. DEWETT, Modern Economic Theory, S. Chand and Company, New Delhi-55

**Reference Books:**

NAM 424 - MARINE INSTRUMENTATION & METROLOGY LABORATORY

Periods/week: 3
Ses.: 50
Exam: 50

Examination Practical: 3hrs
Credits: 2

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.

NAM 425 - COMPUTER AIDED DESIGN & SOFTWARE LABORATORY

Periods/week: 6
Ses.: 50
Exam: 50

Examination Practical: 3hrs
Credits: 2

CAD 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.
Exercise in (a) setting up databases for ship design and production, (b) making a shipbuilding cost model, (c) determining the effect of variables such as fuel cost and freight rate on ship economics.

Tutorial exercises on Software (NAPA and available software)

**NAM 426 – PROJECT**

Periods/week: 9
Ses.: 50
Exam: 50
Credits: 6

The Student has to submit a comprehensive project report on the work done in the IV year 1st and 2nd semesters.

Pre-examination appraisal thro’ Seminar by a committee consisting of BOS Chairman, Head of the Department and Guide.

Final presentation followed by Viva-Voce Examination with the following members.

1. Chairman, Board of Studies.
2. Head of the Department.
3. External Examiner (External to the college)
4. Internal Guide
5. (And) External Guide (if any)