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<th>COURSE</th>
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<th>Exam (hours)</th>
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*Common with Mechanical Engineering.*
B.E. - IV/IV NAVAL ARCHITECTURE AND MARINE ENGINEERING  
( I-SEMESTER )

NAM 411- SEA KEEPING AND MANOEUVRABILITY  
Periods/week : 5.   Ses. : 30    Exam : 70  
Examination Theory : 3hrs.    Credits: 4


5. Stabilization of ship motions: Roll stabilisers- Bilge keels, Gyroscopic stabilisers, 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.


Superstructure – Structural design and details of openings, expansion joints etc. Determination of scantlings, Construction and design of cargo handling systems and equipment – loads on derricks, masts and rigging. Determination of scantlings. Deck cranes –details of installation and structural arrangements necessary.

Hatch covers – loads acting on hatch covers, various types of hatch covers and their structural design. Structural design of special types of ships – fishing vessels, tugs, tankers, dredgers, icebreakers, and submarines.

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

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

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
Examination Theory: 3hrs.
Ses. : 30
Exam : 70
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


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

<table>
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<tr>
<th>Periods/week : 5</th>
<th>Ses. : 30</th>
<th>Exam : 70</th>
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<tr>
<td>Examination Theory: 3hrs.</td>
<td>Credits: 4</td>
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<td>(Common with Mechanical Engg. (With Marine Engg. Electives))</td>
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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.


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-design 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 underwater 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.


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

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
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 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

**Textbook:**  **Sonar for Practicing Engineers – A.D. Waite - Third Edition – John Wiley**

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

Chapter I
Ocean pollution: kinds and quantities of pollutants entering oceans - ocean dumping - fate of pollutants - toxic effects and nuclear waste disposal, Sources and Effects of Marine Pollution.

Chapter II
Oil spills, Fate of spilled oil; Treatment of oil at sea; disposal of oil platforms and other structures at sea, accomplishments and case studies towards reducing pollutant/contaminant inputs to the ocean. Aerial observation of oil; Beach cleaning; Environmental impact; Net Environmental Benefit Analysis; Public health risks and commercial damage; Case Studies

Chapter III
Plastics in the marine environment - Nature of plastic materials - Potential plastic pollutants - Distribution and impact of plastics - Trace metals as pollutants - Factors influencing the toxicity of trace metals to marine organisms – Case studies of marine pollution with reference to Mercury, Cadmium, etc.

Chapter IV
Harmful Algae Bloom: Definition; Causative organisms; Impact; Relation with Eutrophication; In-situ treatment; Case Studies, Pollution by sewage and nutrients - discharges by rivers and estuaries - piped outfalls to the sea - sewage and micro-organisms - Disposal of persistent organic compounds - Effects of persistent organic compounds on marine organisms. How to address the Marine Pollution

Chapter V
IMO and regulatory mechanism to check pollution: Elementary treatment only.

Books Recommended

2. Marine Pollution by Sebastian A. Gerlach, Springer Verlag

NAM 416 - SHIP DRAWING –III


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.

   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
Examination Practical: 3hrs.

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

The student has to chose a project with an internal guide, start the work and continue in second semester.

NAM 419  INDUSTRIAL TRAINING REPORT

Ses: 50
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.
B.E. - IV/IV NAVAL ARCHITECTURE  
( I I-SEMESTER )

NAM 421 – MARINE INSTRUMENTATION & CONTROL SYSTEMS

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

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.


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

References:
NAM 422 – COMPUTER AIDED SHIP DESIGN

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


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. CASD (Computer Aided Ship Design) applications and exposure to CAD packages: Application to ship design, model manufacturing and testing, CAD applications in ship building. Simple examples of computer aided drafting, design and analysis of ships. Introduction to CAD packages like ANSYS, NASTRAN, NISA-

Text Books:

References:
2. CAD/CAM/CIM by Radhakrishna, New age international.
4. Computer Aided ship Design by Panagiotis Kaklis, A-A.I. Ginnis, K.V. Kostas & C. Feurer, National Technical University of Athens (NTUA), School of Naval Architecture and marine engineering (Sname), Ship Design Laboratory (SDL)
5. Computer- Aided analysis & design by S. Ghosal, Prentice Hall of India
**NAM 423 - ENGINEERING ECONOMICS**

Periods/week : 4  
Ses. : 30  
Exam : 70  
Examination Theory: 3hrs.  
Credits:4  
(Common with Mechanical Engineering)

1. Utility, value, wealth, consumption, wants, necessaries, comforts and luxuries. laws of demand, elasticity of demand.

Production, agents of production, laws of returns. Forms of business organisation. Single trader, partnership and public limited company.

Price determination in perfect competition, monopoly and imperfect competition. Rent, interest, money, cheques, bills of exchange.

Costing- Cost concepts, Elements of cost, Methods of distribution of overhead costs. Unit costing, Job costing and process costing.

Break- Even analysis, Depreciation methods, Preparation of profit and loss account and balance sheet (Outlines only).

Text Book:  

References:  
NAM 425 - COMPUTER AIDED DESIGN & SOFTWARE
LABORATORY

Periods/week : 3                       Ses. : 50
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.


CAM experiments:

1. Preparation of manual part programming for CNC turning/Milling.
2. Part programming preparation through AutoCAD.
3. APT part programming for 2D - contour.
4. Machining of one job on CNC machine tool.
5. Robot programming through Teaching Box method.
6. Robot programming through computer.
NAM 426 - PROJECT

Periods/week : 9
Ses. : 100
Exam : 150
Credits: 8

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)