

| B.E IV/IV SEMESTER - I |                                       |                   |              |                 |            |             |         |
|------------------------|---------------------------------------|-------------------|--------------|-----------------|------------|-------------|---------|
| Subject Code           | COURSE                                | Periods (L/T/Lab) | Exam (hours) | Sessional Marks | Exam Marks | Total Marks | Credits |
| NAM 411                | Sea Keeping and Maneuverability       | 5                 | 3            | 30              | 70         | 100         | 4       |
| NAM 412                | Ship Structural Design and Vibrations | 5                 | 3            | 30              | 70         | 100         | 4       |
| NAM 413                | Elective-III                          | 5                 | 3            | 30              | 70         | 100         | 4       |
| NAM 414                | Marine Machinery– II                  | 5                 | 3            | 30              | 70         | 100         | 4       |
| NAM 415                | Elective - IV                         | 5                 | 3            | 30              | 70         | 100         | 4       |
| NAM 416                | Ship Drawing - IV                     | 6                 |              | 100             |            | 100         | 4       |
| NAM 417                | Ship Hydrodynamics Laboratory         | 3                 | 3            | 50              | 50         | 100         | 2       |
| NAM 418                | Project                               | 6                 |              | 100             |            |             |         |
| NAM 419                | Industrial Training Report            |                   |              | 100             |            | 100         | 2       |
|                        | TOTAL                                 | 40                |              | 500             | 400        | 800         | 28      |

| B.E IV/IV SEMESTER - II |  |                   |              |                 |            |             |         |
|-------------------------|--|-------------------|--------------|-----------------|------------|-------------|---------|
| Subject Code            | COURSE                                   | Periods (L/T/Lab) | Exam (hours) | Sessional Marks | Exam Marks | Total Marks | Credits |
| NAM 421                 | Marine Instrumentation & Control Systems | 5                 | 3            | 30              | 70         | 100         | 4       |
| NAM 422                 | Computer Aided Ship Design               | 5                 | 3            | 30              | 70         | 100         | 4       |
| # FE 02                 | Free Elective II                         | 4                 | 3            | 30              | 70         | 100         | 4       |
| * NAM 423               | Engineering Economics                    | 3                 | 3            | 30              | 70         | 100         | 4       |
| NAM 424                 | Metrology & Marine Instrumentation Lab.  | 3                 | 3            | 50              | 50         | 100         | 2       |
| NAM 425                 | Computer Aided Ship Design Laboratory    | 6                 | 3            | 50              | 50         | 100         | 2       |
| NAM 426                 | Project                                  | 9                 |              | 50              | 150        | 200         | 8       |
|                         | TOTAL                                    | 35                |              | 270             | 530        | 800         | 28      |

\*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

1. 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 representations. Descriptive characterisation of the sea. Average and significant wave heights. Wave histogram. Characterisation by energy spectrum. Standard sea spectra. Beaufort scale.

2. Ship motions in regular waves: Surge, sway, heave, roll, pitch and yaw. Coupled and uncoupled motions. Equations of motion, inertial, damping, restoring and exciting forces and moments. Determination of the forces and moments. Tuning factor and Magnification factor. Added mass. Coupled heaving and pitching. Motions in shallow water.

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.

4. Dynamic effects: Relative bow motion. Deck wetness and slamming. Added Resistance in waves. Added power. Power increase due to wind and waves. Loss of speed in a seaway. Loads due to motion. Wave loading and bending moments. Vertical and Rolling effects. Sea sickness

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.

6. Pitch stabilization methods: Ship motion experiments. Generation of Regular and Irregular waves. Captive and free running model tests. Full scale Tests. Design considerations for sea keeping. Seakeeping criteria. ITTC Guidelines. Effect of design parameters and hull form on seakeeping.

7. Introduction to Manoeuvrability: Controlled and uncontrolled motions. Control Loop. Course keeping. Motion stability of ocean vehicles. Equations of motion. Hydrodynamic derivations. Stability criterion. Course changing. Tuning circle, zigzag and spiral manoeuvres. Heel while turning. Manoeuvring trials.

8. Control Surfaces: Control surface geometry. Rudders- types and characteristics. Effect of stall, aeration and cavitation. (Flow around rudder, Influence of ship- features on controls fired stability.) Design of rudders. Calculation of steering gear torque. Bending moment and stresses in rudder stock. Structural design of rudders. Other maneuvering devices. Maneuvering in restricted waters. Squat in shallow water. Bank suction effects- Interaction between ships. Theoretical determination of hydrodynamic derivatives of ship and control surfaces. Experimental determination of hydrodynamic derivatives. Estimation of maneuvering characteristics from hydrodynamic derivatives.

References:

1. Dynamics of Marine Vehicles by Rameshwar Bhattacharya.

2. Principles of Naval Architecture, Vol. III by Ed. V. Lewis

# NAM 412 SHIP STRUCTURAL DESIGN AND VIBRATION

Periods/week : 5.  
Examination Theory: 3hrs.

Ses. : 30      Exam : 70  
Credits: 4

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.

4. Structural Design of Engine Room, Superstructure, Cargo Handling Arrangements, Hatches, Special Ships, Welded Structures and Computer Applications: Engine Room – Horizontal subdivision of engine room, platforms, decks, shaft tunnel and recesses, Engine casting, foundations of Diesel engines, turbines, boilers, auxiliary machinery. Static and dynamic loads in engine room. Structural design of engine room and determination of 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.

Stress Concentration and fatigue in ship structures. Computer applications in structural design. Various methods of joining structural parts and elements. Design of welded structures. Problem of fracture in welded structures. Design and strength of butt – welds, fillet welds, Tee and corner joints, bracketed connections. Structural fire protection.

5. Hull Vibration of Ships: Flexural vibrations of a beam. Free and forced vibrations, vibration of undamped spring-mass system, damped vibrations. The exciting forces on hull of ships, modes of hull vibration. Calculation of hull frequencies – factors influencing frequency, empirical formulae for hull frequency estimation. Analytical methods for calculation of hull modes ( elementary treatment only ). The Stodala's interpolation method.

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

General methods of reducing vibrations. Devices for reducing main hull vibration. Synchronising devices for twin – screw ships, rotating weight neutralisers, Kurt nozzles.

Reference Books:

1. Strength of Ship Structures by W. Muckle
2. Ship Construction by D.J. Evers
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, 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. Determination of main dimensions. Estimation of component weights. Development of lines. Estimation of resistance. Design of propellers for trawlers.

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.
2. Dredgers: Types of dredgers, Hydrostatics and stability construction. Powering and dredging machinery and equipment. Disposal of dredged material. Design considerations.
3. High speed crafts: Their role in offshore and naval operations. Special features. Design considerations
4. Fishing vessels: Types of fishing vessels and fishing methods. Special features. Stability requirements and IMCO recommendations. General arrangement. Fishing gear and equipment. Preservation and processing of catch and by-products. Fishing vessel design.

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  
Examination Theory: 3hrs.

Ses. : 30      Exam : 70  
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 mine dimensions. Volumes based and weight based criteria. Space allocation and general arrangement.
2. Design of Hull Form: Warship resistance data, Hydrodynamics of naval vessels. Propellers for warships. Design and construction. Propeller data for heavily loaded propellers. Hydrodynamic design methods. Stability criteria for warships. Damage survival considerations.
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.
4. Structural arrangements in naval ships: Structural design criteria and design procedures. Shock and methods to reduce its effects. Accommodation. Habitability standards. A/C requirements. Nuclear, bacteriological and chemical defense arrangements. Weapon systems. Guns torpedoes, depth chargers, mines and missiles. Radar and Sonar weapon control systems. Counter Measures.
5. 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.

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

Periods/week : 5

Ses. : 30

Exam : 70

Examination Theory: 3hrs.

Credits: 4

(Common with Mechanical Engg. ( With Marine Engg.Electives))

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-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
2. A Text book of Welding Technology by O.P. Khanna
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
5. Elements of Workshop Technology, Vol.1 by S.K. Hajra Choudury et. al.
6. Welder Trade Theory by S.K. Singh



## NAM 414 - MARINE MACHINERY – II

Periods/week : 5

Examination theory: 3hrs.

Ses. : 30

Exam : 70

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.
3. Stern Tubes: Stern tubes and glands-oil lubricated stern tubes, shaft seals, shaft alignment, thrust block, reduction gearing.
4. Propellers: Types and construction details, fixing maintenance and operation of marine propellers-ship stabilizers.
5. Deck equipment: Engine room and Deck cranes, Windlasses, Mooring Winches, Anchors and Anchor chains, Lifeboats lowering, Shackles, and Chain blocks.  
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.
6. Fire fighting: Fire Prevention – detection and extinction. Principles of operation, application and maintenance of fire extinguishers. Respirators, safety lamps, fire alarms and signals. Fixed fire detection and extinguishing arrangements for accommodation. Cargo holds and machinery spaces. Methods of fire fighting at sea. Pumping systems for fire fighting. 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

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 detectorm, 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:

- 1) Principles & Practices of Marine Diesel Engines – D.K.Sanyal

Reference Books:

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

**NAM 415 – ELECTIVE –IV  
(B) UNDERWATER ACOUSTICS**

Periods/week : 5  
Examination theory: 3hrs.

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 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:

1. Principles of Underwater Sound – (1983) Robert J Urick – Mc Graw Hill Publications
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

Text Book : 1. Clark, R.B. “Marine Pollution”, 5th Edition, Oxford University Press, 2001  
2. Marine Pollution by Sebastian A. Gerlach, Springer Verlag

Reference Books: Marine Pollution, Chris Frid, Martin Atterill and Robert Clark; Oxford University Press, Marine Pollution by Johnson, R., Academic Press, Chemical Oceanography, Volumes 1 to 9, Academic Press, Estuarine Chemistry by Burton and Liss, Academic Press.

## NAM 416 - SHIP DRAWING –III

Periods/week : 6.

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.

**2.** Hull Vibration calculations. Determination of hull girder frequencies. Computer applications to ship design and drawing.

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

Examination Practical: 3hrs.

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.
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.
4. Mathematical Modeling of Physical Systems: Equations of electrical networks, Modeling of mechanical system elements, Equations of mechanical systems. State-variable Analysis of Linear Dynamic Systems: Matrix representation of state equations, State transition matrix, State transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions, Characteristic equation, eigen values and eigen vectors.
5. Time-Domain Analysis of Control Systems: Typical test signals for the time response of control systems, Time- domain performance of control systems- The steady- state error, Time-domain performance of control systems- Stability of control systems- stability, Characteristic equation and the state transition matrix, Methods of determining stability of linear control systems, Routh- Hurwitz criterion.
6. 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.
2. Mechanical Measurements, by R.S.Sirohi, H.G. Radha Krishna, Wiley Eastern, New Delhi.

**References:**

1. Experimental Methods for Engineers, by J.P.Holman, McGraw-Hill.
2. Instrumentation for Engineering Measurements, by R.H. Cerni and L.E.Foster, J.Wiley & Sons, New York.
3. Mechanical and Industrial Measurement, by R.K.Jain, Khanna publishers, Delhi.
4. Control Systems Engineering by Nagrath/Gopal ,New age international.



## NAM 422 – COMPUTER AIDED SHIP DESIGN

Periods/week : 5

Ses. : 30 Exam : 70

Examination Theory: 3hrs.

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.
2. Interactive Computer Graphics - Graphic display devices- Graphics system- Graphics standards - Graphical user interface- Transformation systems- windowing - clipping - 2D and 3D transformations - Linear transformation- Display files for 3D data - Geometric Modeling - Modeling Techniques - Wire frame Modeling - Surface Modeling - 3 D Solid Modeling.
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:**

1. CAD/CAM- Computer Aided Design & Manufacturing, by M.D.Groover & E. W. Zimmer.
2. Computer Aided Design and Manufacturing, by Dr.Sadhu Singh, Khanna Publishers.

### **References:**

1. Elements of Computer Aided Design & Manufacturing, by Y.C.Pao.
2. CAD/CAM/CIM by Radhakrishna, New age international.
3. Computer aided Kinetics for Machine Design, by D.L. Ryan
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
6. Computer Aided design and manufacturing, by C.B. Nesant & C.W.K. Lui.
7. Computer Aided Design in Mechanical Engineering, by V. Rama Murthy.

## **\*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, necessities, 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:

Engineering Economics, Vol.1, Tara Chand.

References:

1. A Text book of Economic Theory by Dhingra and Garg.
2. Cost Accounts by Shukla and Grewal.

## **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.
9. Removal of hidden lines - Shading and rendering.

### 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 1<sup>st</sup> and 2<sup>nd</sup> 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)