

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		50	50	100	2
NAM 419	Industrial Training Report			100		100	2
	TOTAL	40		450	450	900	30

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	Principles of Economics and Management	4	3	30	70	100	4
NAM 424	Marine Instrumentation & Metrology Laboratory	3	3	50	50	100	2
NAM 425	Computer Aided Ship Design Laboratory	6	3	50	50	100	2
NAM 426	Project	9		50	50	100	6
	TOTAL	36		270	430	700	26

For other department students

*Taught by Humanities Department

**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 stabilizers- Bilge keels, Gyroscopic stabilizers, 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, 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.

Design of fishing vessels. Side trawlers, stern trawlers. 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 considerations. 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

**NAM 413 - ELECTIVE –III
(C)NAVAL VESSELS**

Periods/week : 5

Examination Theory: 3hrs.

Ses. : 30

Credits: 4

Exam : 70

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.

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 travelled when submerged and while on surface. Propulsion system. Rudder and hydroplanes. Nuclear submarines.

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

Periods/week : 5

Examination Theory: 3hrs.

Ses. : 30

Credits: 4

Exam : 70

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

Credits: 4

Exam : 70

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

Examination theory: 3hrs.

Ses. : 30

Exam : 70

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:

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

Credits: 4

Exam : 70

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**

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

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. Layout of various compartments/engine room/ tanks.

3. 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

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.

**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. 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:

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. Computer Aided Design in Mechanical Engineering, by V.Rama Murthy.
2. Elements of Computer Aided Design & Manufacturing, by Y.C.Pao.
3. Computer Aided Kinetics for Machine Design, by D.L.Ryan.
4. Computer Aided Design and Manufacturing, by C.B.Besant & C.W.K.Lui.
5. Computer-Aided Analysis & Design by S. Ghosal, Prentice Hall of India.
6. CAD/CAM/CIM by Radhakrishna, New age international.

**# FE 02- FREE ELECTIVE II
COMPUTER AIDED DESIGN**

Periods/week : 4

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. 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:

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. Computer Aided Design in Mechanical Engineering, by V.Rama Murthy.
2. Elements of Computer Aided Design & Manufacturing, by Y.C.Pao.
3. Computer Aided Kinetics for Machine Design, by D.L.Ryan.
4. Computer Aided Design and Manufacturing, by C.B.Besant & C.W.K.Lui.
5. Computer-Aided Analysis & Design by S. Ghosal, Prentice Hall of India.
6. CAD/CAM/CIM by Radhakrishna, New age international.

*NAM 423 – PRINCIPLES OF ECONOMICS AND MANAGEMENT

Periods/week : 4

Examination Theory: 3hrs.

Ses. : 30

Credits:4

Exam : 70

1. **Introduction to Managerial Economics** – Wealth, Welfare and Scarce Definitions of Economics; Micro and Macro Economics; Demand – Law of Demand, Elasticity of Demand, types of elasticity and Factors determining price elasticity of Demand: Utility – Law of Diminishing Marginal Utility and its limitations.
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.
4. **Introduction to Management:** Functions of management – Taylor’s Scientific management; Henry Fayol’s Principles of management; Human Resource management – Basic functions of HR Manager; Man Power Planning, Recruitment, Selection, Training, Development, Placement, Compensation and Performance Appraisal (in brief)
5. **Production Management** – Production Planning and Control, Plant Location, Break – Even Analysis, assumptions and applications.
6. **Financial Management** – Types of Capital: Fixed and Working Capital and methods of Raising Finance; Depreciations: Straight Line and Diminishing Balance Methods. Marketing Management – Functions of marketing and Distribution Channels
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
2. S.C. Sharma and Banga T.R., Industrial Organization & Engineering Economics, Khanna Publications, Delhi -6

Reference Books:

1. A.R. Aryasri, Management Science, Tata Mc Graw – Hill, New Delhi – 20
2. A.R. Aryasri, Managerial Economics and Financial Analysis, Tata Mc Graw – Hill, New Delhi - 20

NAM 424 - MARINE INSTRUMENTATION & METROLOGY LABORATORY

Periods/week: 3
Examination Practical: 3hrs

Ses. : 50 Exam: 50
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, thermistors.
- 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
Examination Practical: 3hrs

Ses. : 50 Exam: 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.

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)