**DEPARTMENT OF MARINE ENGINEERING**
**Proposed Scheme of Instruction and Examination**
**B.Tech (NAVAL ARCHITECTURE AND MARINE ENGINEERING)**
**Effective Admitted Batch 2019-20**

**I / IV Semester - II**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| DS 1208 | Introduction to Naval Architecture | 3 | 1 | -- | 3 | 30 | 70 | 100 | 4 |

**B.E II/IV SEMESTER – I**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 2101 | Engineering Mechanics-I | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2102 | Basic Thermodynamics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2103 | Engg. Science Course( ESC): Introduction to Physical oceanography | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2104 | Ship Building Technology | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2105 | Theory of Ships | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2106 | Mechanics of Materials - I | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2107 | Ship Drawing - I | - | - | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 2108 P | Mechanics of Materials Laboratory | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 2109 | Mandatory Course (MC): Environmental Sciences | | | | - | - | - | - | 0 |
| | | | | | | | | | |
| TOTAL | | 30 | | | 24 | 280 | 520 | 800 | 21 |

**II / IV Second semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 2201 | Engineering Mechanics - II | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2202 | Marine Machinery | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2203 | Material Science (OEC) | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2204 | Electrical Technology (OEC) | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2205 | Engineering Thermodynamics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2206 | Mechanics of Materials - II | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2207P | Electrical Technology Lab | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 2208P | Ship Drawing - II | - | - | 3 | 3 | 50 | 50 | 100 | 1.5 |
| TOTAL | | **30** | | | **24** | **280** | **520** | **800** | **21** |

**III / IV First semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 3101 | Industrial Electronics (OEC) | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3102 | Fluid Mechanics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3103 | Ship Design - I | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3104 | Ship Construction | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3105 | Resistance & Propulsion | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3106 | (PEC-I)<br>a) FEA<br>b) Computer Graphics<br>c) MPPE | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3107 | Marine Thermal Lab | - | - | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 3108 | Ship Drawing - III | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| TOTAL | | **30** | | | **24** | **280** | **520** | **800** | **21** |

**III / IV Second semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 3201 | Strength of Ships | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3202 | Marine Hydrodynamics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3203 | Ship Design - II | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3204 | PEC - II<br>a. Marine RAC<br>b. Introduction to Offshore structures<br>c. Ocean Structures and materials | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3205 | Marine Manufacturing Technology | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3206 | CASD | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3207 | Marine Instrumentation and Metrology lab | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 3208 | CASD Lab | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 3207 | **Mandatory Course (MC):**<br>Indian Constitution/Essence of Indian Traditional Knowledge | - | - | - | - | - | - | - | 0 |
| TOTAL | | 30 | | | 24 | 280 | 520 | 800 | 21 |

**IV / IV First semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 4101 | Sea Keeping and Maneuverability | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4102 | Ship Structural Design and Vibrations | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4103 | **PEC - III**<br>a. FVT<br>b. Design of Small crafts<br>c. Naval Vessels | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4104 | Marine Instrumentation and Control | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4105 | Engineering Economics (HSMC -I) | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4106 | Ship Hydrodynamics Laboratory | | | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 4107 | Project-I | -- | -- | 6 | -- | 50 | 50 | 100 | 5 |
| TOTAL | | *29* | | | *18* | *250* | *450* | *700* | *21.5* |

**IV / IV Second semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 4201 | **PEC-IV:**<br>a. Dynamics of Offshore structures<br>b. Marine Diesel Engines<br>c. Underwater Acoustics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4202 | **PEC - V**<br>a. Advanced Welding Technology<br>b. Advanced Ship Systems<br>c. Marine Pollution | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4203 | Project II | -- | -- | 20 | -- | 50 | 50 | 100 | 10 |
| TOTAL | | 28 | | | 6 | 110 | 190 | 300 | 16 |

**Total Credits: 160**

| **Year** | **I Semester** | **II Semester** | **Total** |
|---|---|---|---|
| First | 19 | 19.5 | 38.5 |
| Second | 21 | 21 | 42 |
| Third | 21 | 21 | 42 |
| Fourth | 21.5 | 16 | 37.5 |
| **Total Credits** | | | **160** |

**I / IV Semester - II**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| DS 1208 | Introduction to Naval Architecture | 3 | 1 | -- | 3 | 30 | 70 | 100 | 4 |

**DEPARTMENT OF MARINE ENGINEERING**
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**Effective Admitted Batch 2019-20**

**B.E II/IV SEMESTER – I**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 2101 | Engineering Mechanics-I | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2102 | Basic Thermodynamics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2103 | Engg. Science Course( ESC): Introduction to Physical oceanography | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2104 | Ship Building Technology | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2105 | Theory of Ships | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2106 | Mechanics of Materials - I | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2107 | Ship Drawing - I | - | - | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 2108 P | Mechanics of Materials Laboratory | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 2109 | Mandatory Course (MC): Environmental Sciences | | | | - | - | - | - | 0 |
| | | | | | | | | | |
| TOTAL | | | 30 | | 24 | 280 | 520 | 800 | 21 |

**II / IV Second semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 2201 | Engineering Mechanics - II | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2202 | Marine Machinery | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2203 | Material Science (OEC) | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2204 | Electrical Technology (OEC) | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2205 | Engineering Thermodynamics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2206 | Mechanics of Materials - II | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 2207P | Electrical Technology Lab | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 2208P | Ship Drawing - II | - | - | 3 | 3 | 50 | 50 | 100 | 1.5 |
| TOTAL | | **30** | | | **24** | **280** | **520** | **800** | **21** |

# B. Tech. II/ IV NAVAL ARCHITECTURE AND MARINE ENGINEERING
# ( I-SEMESTER)

## NAM 2101 Engineering Mechanics-I (Statics)

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

**1. General Principles**
Fundamental concepts, Units of Measurement, SI Units
**Force Vectors.**
Vector Operations, vector addition of forces, Coplanar forces, Cartesian vectors, Position vectors, Force vector directed along a line, dot product

**2. Equilibrium of a Particle**
Condition for the equilibrium of a particle, coplanar force system, Three-dimensional force systems

**3. Force System Resultants**
Moment of a force, scalar and vector formulation, principle of moments, moment of a force about a specified axis, moment of a couple, equivalent system, resultants of a force and couple system, further reduction of force and couple systems, distributed loading

**4. Equilibrium of a Rigid Body**
Conditions for equilibrium of a rigid body, free body diagrams, equations of equilibrium, two and three force members, equilibrium in 3-D, constraints for a rigid body

**5. Structural Analysis**
Simple Trusses, method of joints, zero force members, method of sections, space trusses, frames and machines

**6. Friction**
Characteristics of dry friction, problems involving dry friction, wedges, screws, flat belts

**7. Center of Gravity and Centroid**
Centre of gravity, centre of mass, centroid, composite bodies, pappusGuldinus theorem, distributed loading resultants.

**8. Moments of Inertia**
MI, parallel axis theorem, MI of area by integration, MI of composite areas, product of inertia, Mass MI

**9. Virtual Work**
Principle of VW for particle and rigid body, and system of connected bodies, conservative forces, PE, PE criterion for equilibrium, stability of equilibrium

**Textbook:**
***R C Hibbeler, "Engineering Mechanics – Statics and Dynamics- 14th Edition," Pearson***
References:

1. *Vector Mechanics for Engineers: Statics and Dynamics*, by Ferdinand P. Beer & E. Russell Johnston Jr., McGraw Hill
2. *Engineering Mechanics* by S. P. Timoshenko and D.H.Young, Mc.Graw-Hill.
3. *Engineering Mechanics Statics and Dynamics* 4$^{th}$ed Irving H Shames, Prentice Hall

**NAM 2102 Basic Thermodynamics**

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

**Introduction**: Basic concepts- Thermodynamic systems, Micro & Macro systems- Homogeneous and heterogeneous systems- Pure substance- Thermodynamic equilibrium, State Property, Path, Process- Reversible and irreversible cycles- Energy as a property of the systems

**Thermodynamic Laws:** Zeroth law _First law - Corollaries- Isolated systems and steady flow systems- Specific heats - First law applied to flow systems- Systems undergoing a cycle and change of state- First law applied to steady flow processes- Limitations of first law of thermodynamics.

Second law- Kelvin Plank statement and Classius statement and their equivalence, Corollaries- PMM 1 & PMM 2 - Reversibility and irreversibility- Causes of irreversibility- Carnot cycle- Heat engines and heat pumps- Carnot efficiency- Classius theorem- Classius inequality- Concept of entropy

**Properties of steam:** Use of steam tables- Measurement of dryness fraction- T-S and H-S diagrams.

**Vapor Power Cycles:** Vapor power cycle- Rankine cycle- Reheat cycle and Regenerative cycles- Improvements of efficiency. Binary vapor power cycle.

**Steam Nozzles**: Type of nozzles- Flow through nozzles- Condition for maximum discharge- Nozzle efficiency- Super saturated flow in nozzles- Steam injectors.

**Steam Turbines**: Classification of steam turbines- Impulse turbine and reaction turbine- Compounding in turbines- Velocity diagrams in impulse and reaction turbines- Degree of reaction- Condition for maximum efficiency of reaction turbines

**Condensers:** Classification of condensers - Sources of air leakage in condensers- Condenser efficiency

**Text Books:**

1. Engineering Thermodynamics, by P.K.Nag, Tata McGraw Hill Publications company.
2. Thermodynamics (SI Version) by William Z Black & James G Hartley
3. Thermal Engineering, by M.L.Mathur and F.S.Mehta, Jain Brothers.

**References:**

1. Thermodynamics, by Spolding and Cole.
2. Engineering Thermodynamics Work and Heat Transfer, by G.F.C.Rogers and Y.R.Mayhew, ELBS publication.
3. Fundamentals of Engineering Thermodynamics By E Radhakrishnan
4. Engineering Thermodynamics by Zemansky.

**NAM 2103 Engineering Science Course (ESC)**
**Introduction to Physical Oceanography**

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

**Unit I:**
**Physical properties of seawater**: Temperature, Salinity and Density distributions. Transparency of seawater, Sound in the sea, Light in the sea, Colour of seawater, Sea Ice. Measurement of Temperature and salinity With Depth.
**Unit II:**
**Waves**: wave parameters, deep water waves, shallow water waves, transformation of waves in shallow water, wave generation and dissipation.
**Tides:** Tide producing forces, Types of tides, tidal theories. major tidal constituents-prediction of tides
**Water masses**: T-S diagram, Characteristics of water masses, Deep circulation water masses, Major water masses of the world oceans.
**Unit III:**
**Ocean circulation**: Wind induced currents, Upwelling, sinking; equatorial current system, warm and cold currents of major world ocean, seasonal currents in North Indian Ocean, west ward intensification of currents.
**Coastal processes: T**ransformation of waves– refraction, construction of refraction diagram, diffraction, reflection. Coastal and near shore circulation-long shore currents, rip currents and tidal currents.

**Unit IV:**
**Beach features:** Beach cycles, beach profiles-erosion and accretion, Sediment transport rate – onshore and offshore transport – coastal features – LEO observation
**Beach stability** – artificial nourishment – coastal defence structures – planning and design of coastal structures – tidal inlets and Lakes, deltas.
**Estuaries**: Classification, tides in estuaries, estuarine circulation and mixing, Hydrology and hydrograph, sedimentation in estuaries

**Unit V:**

**Marine geology:** Continental shelf, Slope, Shelf sediments, submarine topography, mid oceanic ridge system, gas hydrates, manganese nodules.
**Marine biology**: Classification of marine environment, Biogeochemical cycles. Influence of Physical parameters (Temperature, salinity, waves, currents, tides etc.). Nitrogen, Phosphorus and Silica controls, Residence time of elements in sea water. Marine Ecosystem: Mangroves, Coral Reefs.

**Text books:**

1. Introduction to Physical oceanography by M.P.M.Reddy.
2. Introduction to Physical oceanography by Robert.H.Stewart.
3. Introduction to dynamical oceanography by S.Pond and G.L.Pickard.
4. Marine Biology by Friedrich, H.
5. Coastal and Estuarine Dynamics by A.T. Ippen
6. Estuaries: A Physical Introduction by K.R. Dyer
7. Elements of physical Oceanography by McClellan

**NAM 2104 Ship Building Technology**

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

**Ship building industry:**
Introduction, characteristics and importance of the ship building industry.Factors affecting its survival and growth. Outline of the world ship building scenario. India's ship building industry - special features. Government policy towards ship building industry.Role of classification societies and statutory bodies in ship design and construction. Different classification societies, and rules of IRS, LRS, ABS, BV, DNV etc. STCW code and ISM code.

**Shipyards and facilities:**
Shipyard organization and functions. Classification of shipyards. Types of shipyard layouts and Layout of a modern shipyard. Shipyard facilities - Steel stockyard and material handling equipments, Workshops viz., Piping, fitting, carpentry, smithy, mechanical, machine, electrical and electronics, painting, rigging and shipwright. Ship building berths and docks. Yard services like transportation, power supply, roads, communication, security, compressed air, water etc., Ship repair, dry dock and floating dock facilities.

**Ship production cycle**:
Enquiry, Design stages, production stages, Tests, trails and commissioning, Preparation of production information. Full scale and reduced scale lofting. Computer oriented methods. Shell plate development and Nesting of plates. Simplifications in structural design. Hull preservation and maintenance. Elementary steps in ship construction. Material preparation, structural assembly, hull construction, outfitting. Hull protection methods. Surface preparation and paintings.

**Estimation of building costs of ship:**
Optimum use of resources. Material and Inventory control. Quality control and inspection, Work measurement systems. Methods of man-hour determination. Ship cost concepts- Tenders and contracts. Government policies for price determination of ships.

**Text book:**
1.Ship Design and Construction by R. Taggart

**Reference Books:**
1.Ship Design and Construction by R. Taggart
2.Ship Building Technology by V.K.Dormindontou et.al.
3.Ship Building under developed Countries by R.P.Gokharan.
4.Industrial Engineering and Management by O.P.Khanna

**NAM 2105 Theory of Ships**

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

1. **Introduction:** Ship, Archimedes principle, principles of flotation, types of ships, nomenclature and geometry. Lines plan, and fairing of lines, displacement and tonnage, TPC, coefficients of forms, wetted surface area. Calculation of area, volume, and first and second moments using Simpson's rule, center of gravity, effect of addition of mass, movement of mass and suspended mass.
2. **Stability of ships and freeboard:** Transverse stability of ships, statical stability at small angles of heel, calculation of BM, metacentric diagram, free surface effect, Inclining experiment, Bonjean curves, hydrostatic curves. Stability at large angles:Statical Stability Curve, angle of loll, wall sided formula, cross curves of stability, polar diagrams, metacentric evolute, particular cases of righting moment, dynamical stability, stability diagrams, effects of external heeling moments, stability criteria.Trim and effects of changes in draught. Free board, Different types of free board, ships types based on free board, ILLC requirements, freeboard calculations.
3. **Subdivision of ships:** Causes and types flooding, volume and surface permeability due to bilging of side compartments. Added weight and buoyancy, methods of calculation, subdivision load lines, margin line, floodable length, permissible length, floodable length curves.
4. **Launching**: Launching arrangement, end launching, side launching, launching calculations, docking and grounding.
5. **Hazards and protection**: Rules and Regulations, SOLAS regulations for subdivision and damage stability for passenger ship. Damage stability requirements of cargo ships. IMO regulations on Damage stability & Hazards and Protection. Grain loading, ship building materials.
6. **General layout of ships**: Layout of main and other decks, disposition of bulkheads and decks, types of main engines, engine room layout, electrical systems for ships.
7. **Ship structure:** General mid ship section structural arrangements for different types of ships, structural layout of general cargo ship, oil tanker, and bulk carrier. Structural members of a ship.
8. **Accommodation in ships**: Design philosophy, living spaces, commissioning spaces, spaces for dining, recreation, services etc. Indian merchant shipping rules and regulations for crew accommodation, accommodation construction using panels, bulkheads, ceiling etc. Insulation of accommodation.
9. **Navigational and Communication aids**: Navigational aids for ship, communication equipment, navigational lights, conventions and rules regarding lights, shapes and sound signal
10. **Tonnage measurement**: Measurement and calculations of tonnage national, Suez Canal and Panama canal rules.

**Text books:**

1.Reeds Naval Architecture
2. Principles of Naval Architecture by J.P.Comstock

**References:**

1.Principles of Naval Architecture by Ed.V.Lewis
2.Ship Stability for Masters and Mates by D.R.Derrick.
3.Basic Ship Theory by K.J.Rawson&E.C.Tupper

**NAM 2106 Mechanics of Materials – I**

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

1. General concepts: stress, strain, lateral strain, stress-strain diagram. Generalisation of Hooke's law. Temperature stresses. Stresses in axially loaded bars. Strain energy Impact loads. Relation between elastic constants.
2. Stress transformation: Transformation of stresses in 2-D problems. Principal stresses in 2-d problems. Maximum shear stresses in 2-d problems. Mohr's circle for stress transformation and principal stresses.
3. Bending moments and shear forces: Types of beams, Types of loads, Types of supports. S.F. and B.M. diagrams for statically determinate beams.Relation between bending moment , shear stress and intensity of loading.
4. Stresses in beams: Simple theory of bending, Flexural formula, Shear stress in beams. Principal stresses in beams.
5. Deflection of beams: Relation between curvature, slope and deflection. Double integration method.
6. Torsional stresses in shafts: Analysis of torsional stresses, power transmitted by circular shafts. Combined bending and torsion. Principal stresses in shafts.
7. Closed and opened coiled helical springs: Analysis of principal stresses in open and closed coiled helical springs.
8. Thin walled cylindrical and spherical vessels: Analysis of stresses and strains.

**Text Books:**

Engineering mechanics of solids by E.P.Popov,second edition ,PHI.

**Reference:**

1. Mechanics of solids by R.C.Hibbler.
2. Analysis of structures by Vazairani and RatwaniVol 1,1993 edition.

## NAM 2107 Ship drawing – I

**Periods/week :3** **Ses. : 50** **Exam : 50**
**Examination Theory: 3hrs.** **Credits: 1.5**

**Theory**

Lines plan: Drawing instruments and other equipment uses. Delineation of lines plan, Drawing of lines plan, Drawing of ship lines from basic Naval Arch Principles. Drawing of ship lines using series data. Special features and characteristics of ship lines. Mathematical representation of ship lines. Computer aided drawing and design. Use of scales and fairing of ship lines. Capacity calculations, capacity plan, scales, Bonjean curves, sectional area curves and their properties.

**Practical:**

Lines plan, capacity plan, Bonjean curves, sectional area curves, special features of ship drawing tables, paper, area curves, tracing paper, pencil drawing and ink tracing techniques. Drawing of curved lines with battens, types of battens. Dos and Don'ts while using battens. Use of French curves and paper strips for fairing lines.

## NAM 2108-P Mechanics of Materials Laboratory

**Periods/week : 3** **Ses. : 50** **Exam : 50**
**Examination Practical: 3hrs.** **Credits: 1.5**

**List of Experiments:**

1. To study the stress strain characteristics (tension and compression) of metals by using UTM.
2. To study the stress strain characteristics of metals by usingHounsefieldTensometer.
3. Determination of compression strength of wood.
4. Determination of hardness using different hardness testing machines- Brinnels, Vickers and Rockwell's.
5. Impact test by using Izod and Charpy methods.
6. Deflection test on beams using UTM.
7. Tension shear test on M.S. Rods.
8. To find stiffness and modulus of rigidity by conducting compression tests on springs.
9. Torsion tests on circular shafts.
10. Bulking of sand.
11. Punch shear test, hardness test and compression test by using Hounsefieldtensometer.
12. Sieve Analysis and determination of fineness number.

**NAM 2109 Environmental Sciences (Mandatory Course (MC)**

**Periods/week :** **Ses. :----** **Exam : ---**
**Examination Theory:** **Credits:---**

**Module 1 : Introduction**

Definition, scope and importance
Measuring and defining environmental development : indicators
(1 Lecture)

**Module 2 : Ecosystems**

Introduction, types, characteristics features, structure and functions of Ecosystems

- Forest
- Grassland
- Desert
- Aquatic (lakes, rivers, and estuaries)

(2 Lectures)

**Module 3 : Environment and Natural Resources Management**

Land resources

- Land as a resource
- Common property resources
- Land degradation
- Soil erosion and desertification
- Effects of modern agriculture, fertilizer-pesticide problems

Forest resources

- Use and over-exploitation
- Mining and dams-their effects on forest and tribal people

Water resources

- Use and over-utilization of surface and ground water
- Floods, draughts
- Water logging and salinity
- Dams-benefits and costs
- Conflicts over water

Energy resources

- Energy needs
- Renewable and non-renewable energy sources
- Use of alternate energy sources
- Impact of energy use on environment

(8 Lectures)

**Module 4 : Bio-diversity and its conservation**

Value of bio-diversity - consumptive and productive use, social, ethical, aesthetic and option values.
Bio-geographical classification of India – India as a mega diversity habitat
Threats to biodiversity-Hot-spots, habitat loss, poaching of wildlife, loss of species, seeds etc.
Conservation of bio-diversity-In-situ and Ex-situ conservation
(3 Lectures)

**Module 5 : Environmental Pollution – Local and Global Issues**

Causes, effects and control measures of

- Air pollution
- Indoor air pollution
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution
- Solid waste management, composting, vermiculture
- Urban and industrial wastes, recycling and re-use

Nature of thermal pollution and nuclear hazards
Global Warming
Acid Rain
Ozone depletion

(8 Lectures)

**Module 6 : Environmental problems is India**

Drinking water, Sanitation and public health
Effects of activities on the quality of environment
Urbanisation
Transportation
Industrialization
Green revolution
Water scarcity and Ground Water depletion
Controversies on major darns – resettlement and rehabilitation of people problems and concerns
Rain water harvesting, cloud seeding and water shed management
(5 Lectures)

**Module 7 : Economy and Environment**

The economy and environment interaction
Economics of development, preservation and conservation
Sustainability : theory and practice
Limits to Growth
Equitable use of resources for sustainable lifestyles
Environmental Impact Assessment
(4 Lectures)

**Module 8 : Social Issues and the Environment**

Population growth and environment
Environmental education
Environmental movements
Environmental Development
(2 Lectures)

**Module 9 : Institutions and Governance**

Regulation by Government
Monitoring and Enforcement of environmental regulation
Environmental Acts
Water (Prevention and Control of pollution) act
Air (Prevention and Control of pollution) act
Envt. Protection act
Wild life protection act
Forest Conservation act
Coastal Zone Regulations
Institutions and policies relating to India
Environmental Governance
(5 Lectures)

**Module 10 : International Conventions**

Stockholm Conference 1972
Earth Summit 1992
World commission for environmental Development (WCED)
(2 Lectures)

**Module 11 : Case Studies**

Chipko movement
Narmada BachaoAndolan
Silent Valley project
Madhura Refinery and TajMahal
Industrialization of Pattancheru

Nuclear reactor at NagarjunaSagar
Tehri dam
Ralegaon Siddhi (Anna Hazare)
Kollerulake – aquaculature
Florosis in Andhra Pradesh

(3 Lectures)

**Module 12 : Field work**

Visit a local area to document and mapping environmental assets – river / forest / grass land / hill / mountain

Study of local environment – common plants, insects, birds

Study of simple ecosystems – pond, river, hill slopes etc.

Visits to Industries, Water treatment plants, affluent treatment plants.

(5 Lectures)

# B.Tech. II / IV - NAVAL ARCHITECTURE AND MARINE ENGINEERING (II-SEMESTER)

## NAM 2201 Engineering Mechanics – II

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

1. **Kinematics of a Particle**
   Introduction. Rectilinear Kinematics: Continuous Motion. Rectilinear Kinematics: Erratic Motion. General Curvilinear Motion. Curvilinear Motion: Rectangular Components. Motion of a Projectile. Curvilinear Motion: Normal and Tangential Components. Curvilinear Motion: Cylindrical Components. Absolute Dependent Motion Analysis of Two Particles.Relative-Motion Analysis of Two Particles Using Translating Axes.
2. **Kinetics of a Particle: Force and Acceleration**
   Newton's Laws of Motion.The Equation of Motion.Equation of Motion for a System of Particles. Equations of Motion: Rectangular Coordinates. Equations of Motion: Normal and Tangential Coordinates. Equations of Motion: Cylindrical Coordinates. Central-Force Motion and Space Mechanics.
3. **Kinetics of a Particle: Work and Energy**
   The Work of a Force.Principle of Work and Energy.Principle of Work and Energy for a System of Particles.Power and Efficiency.Conservative Forces and Potential Energy. Conservation of Energy
4. **Kinetics of a Particle: Impulse and Momentum**
   Principle of Linear Impulse and Momentum.Principle of Linear Impulse and Momentum for a System of Particles.Conservation of Linear Momentum for a System of Particles. Impact.Angular Momentum. Relation Between Moment of a Force and Angular Momentum. Angular Impulse and Momentum Principles.
5. **Planar Kinematics of a Rigid Body**
   Rigid-Body Motion. Translation. Rotation About a Fixed Axis. Absolute General Plane Motion Analysis. Relative-Motion Analysis: Velocity. Instantaneous Center of Zero Velocity. Relative-Motion Analysis: Acceleration. Relative-Motion Analysis Using Rotating Axes.
6. **Planar Kinetics of a Rigid Body: Force and Acceleration**
   Moment of Inertia.Planar Kinetic Equations of Motion. Equations of Motion: Translation. Equations of Motion: Rotation About a Fixed Axis. Equations of Motion: General Plane Motion.
7. **Planar Kinetics of a Rigid Body: Work and Energy**
   Kinetic Energy. The Work of a Force. The Work of a Couple. Principle of Work and Energy. Conservation of Energy.
8. **Planar Kinetics of a Rigid Body: Impulse and Momentum**
   Linear and Angular Momentum.Principle of Impulse and Momentum.Conservation of Momentum.Eccentric Impact.

**Textbook:**

R C Hibbeler, Ashok Gupta, "Engineering Mechanics – Statics and Dynamics," 11th Edition, Pearson Education

References:


1. *Vector Mechanics for Engineers: Statics and Dynamics*, by Ferdinand P. Beer & E. Russell Johnston Jr., McGraw Hill
2. *Engineering Mechanics* by S. P. Timoshenko and D.H.Young, Mc.Graw-Hill.
3. *Engineering Mechanics Statics and Dynamics* 4thed Irving H Shames, Prentice Hall

**NAM 2202 Marine Machinery**

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

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

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

*3. Propellers and Rudders: Types and construction details, fixing, maintenance and operation, ship stabilizers.*

*4. Deck equipments: Engine room and Deck cranes, Windlasses, Mooring Winches, Anchors and Anchor chains, Lifeboats, Shackles, and Chain blocks.*

**5. Marine pumps and equipments :** Details of pumps for marine purposes- condenser circulating pumps, condensate and drain pumps, air pumps, boiler feed pumps, Performance characteristics of Pumps, power pumps - rotary pumps. Evaporators, distillers, Ejectors, strainers and filters, coolers, centrifuges, purifiers and clarifiers, their purpose, applications in Marine use. Details of construction.

**6. Marine Piping:** Various types of piping systems fitted in ships, expansion arrangements for pipes, valves and fittings. Types used in marine practice, materials and corrosion in pipes, color codes for different pipes.

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

**Textbook:**

1.Marine Auxiliary Machinery by W.J.Fox

**References:**

1.Marine Engineering by R.Harrington
2.Marine Auxiliary Machinery by D.W. Smith and Souchotte
3.Reed's General Engineering Knowledge for Marine Engineers
4. Material Handling by N.Rudenko
5. Principles of Naval Architecture by J.P. Comstock.

**NAM 2203 Material Science (OEC)**

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

**Space lattice and unit cells.**Crystal systems.Indices for planes and directions.Structures of common metallic materials. Crystal defects: Point, Line and Surface defects & effects on properties.

**Solid solutions.Intermediate phases.** Inter metallic compounds. Gibbs rule. Binary phase diagrams. Lever rule.Invariant reactions. Iron-Iron Carbide phase diagram. Heat treatment of steel. Isothermal transformation curves. Annealing, Normalizing, Hardening, Tempering, Austempering andmartempering of steels. Surface hardening of steels.Carburizing, Nitriding, Cyaniding, Flame and Induction hardening methods.

**Classification of steels:** I.S., AISI - SAE classifications. Use and limitations of plain-carbon steels. Alloy steels. Plain carbon and low alloy steels. Tool steels. Cemented carbides. Stainless steels. Maraging steels. Hadfield steel.Cast irons. Grey, White, Malleable and SG irons. Alloy cast-irons. Non-ferrous metals and alloys.Copper and copper-base alloys.Brasses and the bronzes. Copper nickel and Monel alloys. Properties and applications.Aluminium, its uses. Wrought and cast alloys of aluminium.

**Plastic deformation:** Slip, twining critical resolved shear stress. Ductile and Brittle fracture..Mechanism of Creep and Fatigue. High temperature alloys. Metals at low temperature. Effect of low temperature on properties: Low temperature metals. Powder Metallurgy.Basic steps in and typical applications of powder metallurgy.

**Composite materials.**Classification.Matrices and reinforcements.Fabrication methods.Examples and applications.

**Text Books:**

1. Materials Science and Engineering, by V.Raghavan.
2. Physical Metallurgy, by S.H.Avner.

**References:**

1. Materials Science and Engineering by L.H.VanVleck, Fifth Edition, Addison-Wesley (1985).
2. Structure and Properties of Materials by R.M.Rose, L.A.Shepard and J.Wulff, Vol.1-4, John Wiley (1966).
3. Essentials of Materials Science by A.G.Guy, McGraw-Hill (1976).
4. The Science and Engineering of Materials by D.R.Askeland, Second Edition, Chapman and Hall (1990).

**NAM 2204 Electrical Technology (OEC)**

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

**Magnetic Circuits:** Definitions of magnetic circuit, Reluctance, Magneto motive force (m.m.f.), Magnetic flux, Simple problems on magnetic circuits, Hysteresis loss. (Chapter-8, Pages 155-175).

**Electromagnetic Induction:** Faraday's laws of Electromagnetic induction, Induced E.M.F., Dynamically induced E.M.F., Statically induced E.M.F., Self inductance, Mutual inductance. (Chapter-9, Page 176-190).

**D.C. Generators:** D.C. generator principle, Construction of D.C. generator, E.M.F. equation of D.C. generator, Types of D.C. generators, Armature reaction, Losses in D.C. generator, Efficiency, Characteristics of D.C. generators, Applications of D.C. generator. (Chapter-10, 11, Pages 208-238).

**D.C. Motors:** D.C. motor principle, Working of D.C. motors, Significance of back E.M.F., Torque equation of D.C. motors, Types of D.C. motors, Characteristics of D.C. motors, Speed control methods of D.C. motors, Applications of D.C. motor. Testing of D.C. machines: Losses and efficiency, Direct load test and Swinburne's test. (Chapter-12,13, Pages 239-267).

**A.C. Circuits:** Introduction of steady state analysis of A.C. circuits, Single and balanced 3-phase circuits. (Chapter-16, pages 323-348).

**Transformers:** Transformer principle, EMF equation of transformer, Transformer on load, Equivalent circuit of transformer, Voltage regulation of transformer, Losses in a transformer, Calculation of efficiency and regulation by open circuit and short circuit tests. (Chap-20, p 423-455).

**Three Phase Induction Motor:** Induction motor working principle, Construction of 3-phase induction motor, Principle of operation, Types of 3-phase induction motor, Torque equation of induction motor, Slip-torque characteristics, Starting torque, Torque under running condition, Maximum torque equation, Power stages of induction motor, Efficiency calculation of induction motor by direct loading. (Chapter-21, pages 463-489).

**Alternator:** Alternator working principle, EMF equation of alternator, Voltage regulation by sync. impedance method. (Chapter-23, pages 505-515).

**Synchronous Motor:** Synchronous motor principle of operation, Construction, Methods of starting of synchronous motor. (Chapter-24, pages 516-526).

**Electrical Measurements:** Principles of measurement of current, voltage, power and energy, Types of Ammeters, Voltmeters, Watt-meters, Energy meters, Electrical conductivity meter, Potentiometer, Megger.

**Text Book:**

1. Elements of Electrical Engineering and Electronics by V.K. Mehta, S. Chand & Co.

**Reference:**

1. First Course in Electrical Engineering by Kothari.

**NAM 2205 Engineering Thermodynamics**

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

**1. I.C. engines:** classification, comparison of two stroke and four stroke engines, comparison of S.I. and C.I. engines. Air cycles- Otto, Diesel, Dual, Sterling, Ericson and Atkinson cycles and their analysis. Valve timing and port timing diagrams Various Efficiencies. Basic principles of carburetion and fuel injection.

**2. Combustion in I.C. Engines:** S.I. engines- Normal combustion and abnormal combustion- Importance of flame speed and effect of engine variables, types of abnormal combustion pre-ignition and knock, Fuel requirements and fuel rating, anti-knock additions- Combustion chamber requirements and Types of combustion chamber

**3. Reciprocating and Rotary Compressors:** Reciprocating compressors, effect of clearance volume in compressors, volumetric efficiency, single stage and multi stage compressors, effect of inter cooling in multi stage compressors. Centrifugal compressor- Adiabatic efficiency- Diffuser- Axial flow compressors

**4. Gas Turbines:** Simple gas turbine plant- closed cycle and open cycle for gas turbines. Efficiency, work ratio and optimum pressure ratio for simple gas turbine cycle. Parameters of performance- regeneration, Inter-cooling and reheating, closed and semi-closed cycle.Jet propulsion and Rockets.

**5. Refrigeration& Air Conditioning:** Bell Colemen cycle, Vapor compression cycle. Vapor absorption system, Principles ofpsychrometry –psychometric Chart and terminology, air conditioning systems.

**Text Books:**
1. Internal Combustion Engine fundamentals by Heywood J B, ISBN0-07-100499-8 Mc. Graw Hill Company.
2. Applied Thermodynamics-II by R. Yadav.
3. A Treatise on Heat Engineering by Vasandhani and Kumar.

**References:**
1. I.C. Engines by V. Ganesan.
2. Thermal Engineering, by R.K.Rajput.
3. I.C. Engines, by Mathur and Nehata.
4. Gas Turbines, by Cohen and Rogers.
5. Fluid Flow Machines, by M.S. GovindaRao, Tata McGraw Hill publishing company Ltd.
6. Refrigeration and Air-conditioning, byC.P.Arora and Domokundwar.

**NAM 2206 Mechanics of Materials – II**

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

1. Statically indeterminate Beams :
   Fixed Beams: Fixing moments of a fixed beam of uniform cross section.Effect of sinking of supports,Slope and deflection.
   Continuous beams : Analysis of continuous beams ,Reaction at the supports, Effect of sinking of supports.B.M. and S.F. diagrams.

2. Columns and struts: Introduction,Examples of instability,Criteria for stability of equilibrium.Euler's buckling theory –columns with pinned ends,Columns with different end restraints,Limitaions of Euler's formulae. Column carrying eccentric loads,Empirical formulae.
3. Bending of curved bars: Stresses due to bending of curved bars of circular,rectangular and trapezoidal sections,curved bars subjected to eccentric loads such as crane hook.

4. Thick cylinders: Subjected to internal and external pressure cylinders.
5. Theories of failure: Application to design of shafts.

**Text Books :**


1. Engineering mechanics of solids by E.P.Popov,second edition ,PHI.
2. Mechanics of solids by R.C.Hibbeler.
3. Strength of materials by L.B.Shah and DrR.T.Shah

## NAM 2207P – Electrical Technology Lab

**Periods/week : 3** **Ses. : 50** **Exam : 50**
**Examination Practical: 3hrs.** **Credits: 1.5**

**List of Experiments:**

1. Study and Calibration of wattmeter and energy meter.
2. Measurement of armature resistance, field resistance and filament resistance.
3. Verification of KCL and KVL.
4. Superposition theorem.
5. Parameters of a choke coil.
6. OC and SC tests on transformer.
7. Load test on D.C. shunt machine.
8. O.C. test on D.C. separately excited machine.
9. Swinburnes test.
10. 3 phase induction motor (No load and rotor block tests) load tests.
11. Alternator regulation by Syn. Impedance method.

## NAM 2208P Ship Drawing – II

**Periods/week : 3** **Ses. : 50** **Exam : 50**
**Examination Practical: 3hrs.** **Credits: 1.5**

**Theory (Hydrostatic calculations**: )
Calculation of hydrostatic properties of ships, displacement sheet, appendage corrections, plotting of hydrostatics, scales. Relationship if any between various hydrostatic curves, practical use of hydrostatic curves for transverse and longitudinal stability calculations.
**Practical:** Calculation and plotting of hydrostatic curves.

**DEPARTMENT OF MARINE ENGINEERING**
**Proposed Scheme of Instruction and Examination**
**B. Tech (NAVAL ARCHITECTURE AND MARINE ENGINEERING)**
**Effective Admitted Batch 2019-20**

**III / IV First semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 3101 | Industrial Electronics (OEC) | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3102 | Fluid Mechanics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3103 | Ship Design - I | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3104 | Ship Construction | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3105 | Resistance & Propulsion | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3106 | (PEC-I)<br>d) FEA<br>e) Computer Graphics<br>f) MPPE | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3107 | Marine Thermal Lab | - | - | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 3108 | Ship Drawing - III | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| TOTAL | | **30** | | | **24** | **280** | **520** | **800** | **21** |

**III / IV Second semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 3201 | Strength of Ships | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3202 | Marine Hydrodynamics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3203 | Ship Design - II | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3204 | PEC - II<br>a. Marine RAC<br>b. Introduction to Offshore structures<br>c. Ocean Structures and materials | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3205 | Marine Manufacturing Technology | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3206 | CASD | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 3207 | Marine Instrumentation and Metrology lab | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 3208 | CASD Lab | -- | -- | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 3207 | **Mandatory Course (MC):** Indian Constitution/Essence of Indian Traditional Knowledge | - | - | - | - | - | - | - | 0 |
| TOTAL | | 30 | | | 24 | 280 | 520 | 800 | 21 |

## B.Tech. III / IV - NAVAL ARCHITECTURE AND MARINE ENGINEERING
## (I-SEMESTER)

### NAM 3101 - Industrial Electronics (OEC)

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

**1. Devices:** Semi-conductor diode, Zenor diode - Transistor - Silicon control rectifier.
Rectifiers, Amplifiers, Oscillators, Cathode ray oscilloscope.

**2. Industrial Applications**: Poly-phase rectifiers - Control circuits - Motor speed control voltage control, Time delay relay circuits - Photo electric circuits.
Resistance welding, Inducting heating - Dielectric heating.

**3. Servomechanism:** Open loop and closed loop systems (Elementary treatment only).

**4. Introduction to Digital Electronics:** Fundamentals of digital electronics, Number system and codes, Logic gates, Boolean algebra, Arithmetic - logic units, Flip-flops, Registers and counters, Memories: ROM, PROM, EPROM and RAM.

**5. Introduction to Microprocessors:** The Intel-8085 microprocessor; Architecture, Instruction set, Execution of instructions, Addressing structures, Timing and machine cycles of 8085 and programming I/O operations, Interrupts, Serial input and serial output, Programming the I/O ports, Programming the timer.

**Text Books:**

1. Industrial Electronics by Mithal (Khanna Publications).
2. Digital Computer Electronics - An Introduction to Micro Computer by Albert Paul Malvino, Tata McGraw-Hill Publishing Co. Ltd., New Delhi-2.

**References:**

1. Engineering Electronics by Ryder-McGraw Hill.
2. Micro Processors by Leventhal.
3. Industrial Electronics by Bhatacharya, Tata Mc-Graw Hill.
4. Industrial Electronics and Control by S.K. Bhatacharya and S. Chatarjee, 1995 Ed., Tata Mc-Graw Hill Pub. Co. Ltd.

**NAM 3102 Fluid Mechanics**

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

1. Basic Concepts and properties of fluids – pressure and its measurement – hydrostatic forces on surfaces .
2. Fluid kinematics: Description of fluid motion – Langrangian method – Eulerian Method. Types of fluid flow-steady and unsteady flows-uniform and non-uniform flows-one, two and three dimensional flows-rotational and irrotational flows-laminar and turbulent flows-compressible and incompressible flows. Types of flow lines-path line-stream line -stream tube- streak line – Rate of flow or discharge. Continuity equation. Continuity equation in Cartesian co-ordinates. Equation of continuity in polar co-ordinates. Circulation and vorticity. Velocity potential and stream function-velocity potential-stream function-relation between stream function and velocity potential. Flow nets-methods of drawing the flow nets-uses and limitations of flow nets
3. Fluid Dynamics:- Equations of Motion-Euler's Equation of Motion-Bernoulli's Equation from Euler's Equation-Application Bernoulli's Equation-Venturimeter , orifice meter and pitot-tube-the momentum Equation-Moment of Momentum equation-Free liquid jets.
4. Laminar and turbulent flow, and flow through pipes: Introduction, Reynolds experiment, flow of viscous fluid through circular pipes and between two parallel plates-loss of head due to friction in viscous flow-turbulent flow-frictional losses in pipe flow – expression for the loss of head due to friction in pipes and coefficient of friction in terms of shear stress- J Boussinesq expression for shear stress in turbulent flow-Reynolds's shear stress and Prandtl mixing length theory for turbulent shear stress-velocity distribution in turbulent flow in pipes-Hydro dynamically smooth and rough boundaries-velocity distribution for turbulent flow for smooth and rough pipes-loss of energy in pipes-All major and minor losses-loss of head energy due to friction –Hydrostatic gradient line(H.G.L) and Total energy line(T.E.L)-Flow through pipes in series, compound pipes, parallel pipes and branched pipes-Power transmission through pipes-Flow through nozzles-water hammer in pipes
5. Dimensional and Model Analysis: Dimensional Homogeneity – Methods of Dimensional Analysis – Rayleigh's Method- π-Theorem – Model Analysis – Similitude-Types of similarities – Dimensionless Numbers – Reynolds's numbers etc…- Model laws of similarity laws – model testing of partially submerged bodies.

6. Boundary Layer Flow: Laminar Boundary Layer- turbulent layer and Laminar sub-layer – Boundary layer thickness (δ) – displacement thickness (δ*) and momentum thickness – energy thickness (δ**) - Drag force on a flat plate due to boundary layer-Turbulent Boundary layer on a flat plate – analysis of turbulent boundary layer – total drag on a flat plate due to laminar and turbulent boundary layer – separation of boundary layer.
7. Forces on Submerged Bodies : Force exerted by a flowing fluid on a stationary body – Expression for Drag and lift – dimensional analysis of drag and lift- Drag on a sphere – terminal velocity of a body – Development of lift on a circular cylinder – Magnus effect – Development of lift on an airfoil
8. Compressible flow – thermodynamic Relations – Basic equations of compressible flow – Velocity of sound or Pressure wave in a fluid etc..- Mach number- stagnation properties - Area velocity relationship for compressible flow – flow of compressible fluid through orifices and nozzles fitted to a large tank – Rate of flow is equal to sonic velocity and pitot-static tube in a compressible flow

**Text Books:**

**1.** Fluid Mechanics and Hydraulic Machines, by R.K. Bansal, Laxmi publications.
**2.** Fluid Mechanics and Hydraulic Machines by R.K. Rajput, s. Chand & Co.

**References**:

1. foundations of fluid Mechanics, by Yuan, prentice Hall of India
2. Fluid Mechanics and its applications, by S.K. Gupta and A.K. Gupta, Tata McGraw Hill, New Delhi
3. fluid Mechanics, by A.K. Mohanty, Prentice Hall of India Pvt .Ltd

**NAM 3103 Ship Design – I**

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

1. **General Considerations and Introduction to Ship Design Methods:** Marketing, manufacturing and operational considerations in Ship design. Technological, economic and sociological factors and national priorities. Ship design as a science and as an art. Owner's requirements, shipyard production facilities and operational constraints to be considered in the design process. Introduction to ship design method using basic ship or parent ship types, ship design as an iterative process and stages of ship design. The design spiral, design ship categories such as dead weight carriers, capacity carriers, and linear dimension ships. Displacement and volume estimation. Dead weight-displacement ratio, components of dead weight and displacement, determination of main dimensions and form coefficients, use of computers in ship design process.

2. **Estimation Of Weight And Volume Components, Design Of Hull Form And Determination Of Stability And Other Criteria:**
Weight and capacity equations and their use in ship design. Use of cubic equation. Calculation of weight and volume components using parent ship data or other compiled data. Calculation of steel, wood, outfit and machinery weights, using formulas. Estimation of dead weight components, design of hull form from first principles. Sectional area curve. Design of load water line, sections, stem and stern profiles, other water lines and development of the lines plan., determination of position of the LCB. Preliminary estimation of power and propeller diameter. Preliminary check for rudder area. Use of series data such as BSRA series and Taylor's series. Calculation of stability, free board, trims capacity and tonnage. Stowage factors. Volume required for cargo fuel fresh water and Ballast.

**3. Determination of Engine Power and Selection of Main and Auxiliary Machinery:**
Calculation of engine power. Relation between resistance and engine power. Criteria for selection of main propulsion plant. Types of main propulsion plants and fuels-their advantages and disadvantages. Different types of power transmission and shafting systems used in ships. Selection of propeller. Propeller types and number and estimation of main propeller parameters, such as diameter, rpm, number of blades, blade area ratio etc. Determination of location, area and volume of engine room. Estimation of size of engine casing. Estimation of electrical power requirement in the ship and deck area and volume required for installation of generators and main switchboard. Functions of various other auxiliary machinery such as boilers, cargo pumps, fuel and lube oil pumps, separators, cooling systems etc.

4. **Cargo Systems and Cargo Handling Gear:** Introduction to various types of cargo systems and cargo handling gear used on board ships such as cranes, derricks, Sampson posts, pumping systems etc. Properties and requirements for carriage of different types of cargo. General cargo carriers, light and heavy bulk cargo carriers and ore carriers. Unitised cargo- pallets, containers, barges, etc. and specialised ships for their carriage. Wheeled cargoes. RO-RO ships and ferries. Liquid cargoes-oil tankers liquefied gas carriers and chemical tankers. Selection of cargo handling gear-arrangements for general, bulk, unitised and liquid cargoes. Piping arrangement for tankers.

5. **Important Design Features of Various Types of Ships and other Considerations:** General cargo carriers, container ships, oil tankers, passenger vessels, bulk carriers, fishing trawlers, tugs, dredgers, barges, ferries. Different types of hull forms, propulsion systems, main and auxiliary machinery, cargo handling systems and operational requirements suitable of the above mentioned ships. Other consideration in ship design such as water tight integrity, damage stability, manoeuvring and sea keeping criteria, propulsive efficiency, minimisation of hull vibrations, compartments and super structure design in different types of ships. Trimming calculations in various operating considerations. Ballasting arrangements and estimation of total ballast.

**Reference Books:**

1. Ship Design and Construction by R.Taggart
2. Basic Ship Theory, Vol.1 & 2 by K.J.Rawson and E.C.Tupper
3. Principles of Naval Architecture, Vol. 1,2&3 by Ed.V. Lewis

**NAM 3104 Ship Construction**

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

**Introduction to ship building and materials used:**
A typical ship construction program. Building berth. Building Dock. Multi-stage construction methods. Equipment used in building berths. Use of Goliath cranes. Floating Docks. Ship types. Shipyard layout. Classification societies, development and application of classification rules, role of statutory bodies. Materials for ship construction. Structural steels, special steels, non- ferrous steels, non-metallic materials, material properties and testing of materials. Joining methods of materials, non-destructive testing.

**Storage and preparation of material and structural elements:**
Material handling and storage, transport system in steel stockyard, material preparation devices- cleaning, marking processes. The cutting process, Mechanical cutting, thermal cutting, optically and numerically controlled cutting, bending of rolled and built-up sections, plate bending. Nesting of plates.

**Fabrication of sub assemblies, units and hull erection:**
Process of prefabrication, welding in prefabrication and erection stages, sub-assemblies, flat sections, panels- flat and curved, double bottom sections, side tank units, fore-end and aft-end structures, deck and bulkhead structures. Assembly of hull-units. Erection of hull-units on building berth/dock.

**Ship structural components:**
Functions and details of ship structural components, framing systems, single and double bottom construction, shell and deck plating, bulkheads, pillars, girders and hatch -coaming, machinery casings, super structures and deck- houses. Bow and stern Structures. Bossing and struts, bilge keels and fenders.

**Out Fitting, Welding, Testing And Trials And Launching:**
Various components of outfitting, consisting of systems, equipment and fittings of hull, machinery and electrical groups. Hull Preservation methods. Various outfitting methods. Advanced outfitting. Methods of welding, metallurgy of welding weld defects, distortion and stresses in welds, testing of welds. Inspection and testing during various stages of ship construction. Testing of structures and tanks. Bollard tests and sea trials. Details of launching arrangements.

**References:**
**1.** Merchant Ship Construction by D. A. Taylor
**2.**Ship Construction by D.J. Eyres
3.Ship Design and Construction by R.Taggart
4**.**Ship Building Technology. By J.H.Dixon

**NAM 3105 Resistance & Propulsion**

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

**1. Introduction to resistance:** Concept of resistance, flow of non-viscous and viscous fluids past submerged bodies and surface of ships. Introduction to important components of resistance such as frictional resistance, wave making resistance, eddy making resistance and air & wind resistance. Dimensional analysis, conditions of similarity, corresponding speeds of ship and model, Introduction to towing tank experiments and determination of ship resistance.

**2. Viscous resistance and air & wind resistance:** Froude's experiments with planks and plates, Reynold's experiments with pipes. Turbulence stimulation, friction lines, form resistance, boundary layer separation, effect of hull roughness, appendage drag, resistance in shallow water full scale tests and ship model correlation.

**3. Wave resistance, estimation of total resistance and effective horsepower**: Kelvin wave pattern, waves generated by ship, wave interference, Froude's method of resistance prediction. Resistance data presentation, estimation of total resistance and effective power, trail and service allowances. Aspects of hull form design. Statistical analysis of resistance data by regression.

**4. Propeller Design and hull propeller interaction:** Screw propeller terminology and geometry. Dimensional analysis and conditions of similarity. Propeller in open water. Propeller coefficients, hull-propeller interaction, wake and thrust deduction, hull efficiency, relative rotative efficiency, propulsive coefficient. Cavitation, fully cavitating propellers. Propeller design using methodical series data, design of free running propellers, propellers for tugs and trawlers. Elementary treatment including basic principles of momentum theory, blade element theory, lifting line theory and lifting surface theory of propeller. Design of propellers for a variable wake.

**5. Ship Propulsion devices, prediction of ship's power and strength of propellers**: Ship Propulsion devices and their historical development, water jet propulsion, controllable pitch propellers, vertical axis propellers, shrouded propellers, tandem and contra-rotating propellers and paddle-wheels, super conducting electric propulsion. Model propulsion experiments in towing tanks and Cavitation tunnels. Ship trails and service performance analysis, estimation of power based on model experiments and propeller design charts, use of $B\rho$- $\delta$ charts,

Kt- Kq- J diagrams. Propeller blade strength methods of calculation, classification society rules, Propeller materials.

**Reference Books:**

1.Principles of Naval Architecture, Vol. II by Ed.V.Lewis.
2.Resistance and Propulsion of Ships by S.A.Harvald**.**
3.Marine Propellers and Propulsion by J.C.Carlton.

## NAM 3106 (A) FINITE ELEMENT ANALYSIS (PEC-I)

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

**1. Fundamental Concepts**: Introduction, Historical background, Outline of presentation, Stresses and Equilibrium, Boundary conditions, Strain-Displacement relations, Stress-Strain relations, Plane stress, Plane strain problems, Temperature effects, Potential energy and equilibrium. The Rayleigh-Ritz method, Hamilton's principle. Galerkin's method, Saint Venant's principle.

**2. One-dimensional Problems**: Introduction, Finite element modeling, Coordinates and Shape functions. The potential energy approach. The Galerkin approach, Assembly of the global stiffness matrix- mass matrix and load vector, Treatment of boundary conditions, Quadratic shape functions, Temperature effects. Trusses: Introduction, Plane trusses, Three-dimensional trusses, Assembly of global stiffness matrix for the Banded and Skyline solutions.

**3. Two-dimensional Problems Using Constant Strain Triangles**: Introduction, Finite element modeling, Constant strain triangle, In plane and Bending, problem modeling and boundary conditions.

**4. Axisymmetric Solids Subjected to Axisymmetric Loading**: Introduction, Axisymmetric formulation, Finite element modeling, Triangular element, Problem modeling and boundary conditions.

**5. Two-dimensional Isoparametric Elements and Numerical Integration:** Introduction, The four-node quadrilateral, Numerical integration, Higher-order elements. Beams and Frames: Introduction, Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports, Plane frames.

**Text Book:**

1. Introduction to Finite Elements in Engineering, by Tirupathi R. Chandrupatla, Ashok D.Belegundu (chapters 1 to 8 only).

**References:**


1. Introduction to Finite Element Method, by Abel & Desai.
2. Finite Element Method, by O.C. Zienkiewicz.
3. Concepts and Applications of Finite Element Analysis, by Robert D. Cook.
4. Introduction to Finite Element Method, by J.N.Reddy.

**NAM 3106 (B) Computer Graphics (PEC-I)**

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

Representing and displaying images, Modifying and understanding images, Chaos, Attractors, and Fractals, Graphics primitives: lines, circles, ellipses, Polygons
Rasterization & 2-D anti-aliasing, 2-D Transformations, 2-D Viewing, 2-D Clipping, Hierarchical modeling system , 3-D Transformations, 3-D Viewing pipeline
3-D Hierarchical Modeling system, 3-D object models, Splint curves & surfaces, Hidden surface removal, Z-buffer algorithm, Shading Midterm Exam (Oct 28)
Illumination models, Rendering techniques, Texture-Mapping, Animation, Particle Systems, Behavioral Modeling, Radiosity & Ray-Tracing, Rendering 3-D data .

Textbooks:

1. Computer Graphics by Rogers and Rogers & Adams.
2. Graphics fundamentals by Shirley
3. l CG mathematics by Lengye.

References:


1. D. F. Rogers, Procedural Elements for Computer Graphics, 2nd Ed., McGraw-Hill, Boston, MA, 1998. (suggested text)
2. P. Shirley, Fundamentals of Computer Graphics, 1st ed, AK Peters Ltd, 2002. (suggested text)
3. Hearn, D., and M. P. Baker, Computer Graphics (C Version), 2nd Ed., Prentice Hall, Upper Saddle River, NJ, 1997. (alternative text)
4. A. Watt, 3D Computer Graphics, 3rd Ed., Addison-Wesley, Reading, MA, 2000. (alternative text)
5. Foley, Van Dam, Feiner, Hughes, and Phillips, Introduction to Computer Graphics, Addison-Wesley, Reading, MA, 1994. (alternative text)
6. E. Lengyel, Mathematics for 3D Game Programming and Computer Graphics, 2nd ed., Charles River Media, 2003. (suggested graphics math text)
7. D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, 2nd Ed., McGraw-Hill, Boston, MA, 1990. (suggested graphics math text)
8. M. Mortenson, Mathematics for Computer Graphics Applications: An Introduction to the Mathematics and Geometry of Cad/Cam, Geometric Modeling, Scientific Visualization, and Other CG Applications, 2nd ed, Industrial Press, 1999. (alternative graphics math text)
9. P. Schnelder, D. Eberly, Geometric Tools for Computer Graphics (Morgan Kaufmann Series in Computer Graphics and Geometric Modeling), 1st ed, Morgan Kaufmann, 2002. (alternative graphics math text)
10. F. Dunn and I. Parberry, 3D Math Primer for Graphics and Game Development, 1st ed., Wordware Publishing, 2002. (alternative graphics math text)

**NAM 3106 (C) MARINE POWER PLANT ENGINEERING (PEC-I)**

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

**1. Introduction:** Classification of Power Plants, Comparison between land based and Marine Power Plants Performance Characteristics of Marine Power Plants, Fuel Consumption under varying conditions, Marine Power Plants layout.

**2. Marine boilers**: Marine Boilers of Fire Tube, Composite and water-tube boilers. Feed water treatment. Feed water supply systems and controls.

**3. Marine steam turbines:** Construction details, Compounded steam turbines for Marine applications, Operation and maintenance.

**4. Marine gas turbines:** Gas Turbine cycles for Marine applications, Recent trends and developments, Free piston engines, Combined Cycle Plants.

**5. Nuclear power plants:** Nuclear fission reaction, types of reactors, Fuels, moderators, Coolants, Control and safety rods, radiation hazards and shielding, Radioisotope applications, Radioactive Waste disposal, Nuclear Powered propulsion, Indian reactor developments.

**6. Marine Refrigeration and Air Conditioning**: Marine refrigeration systems- operation and maintenance-application in modern passenger ships, bulk carriers and refrigerated vessels. Air conditioning systems on board the ships-temperature and humidity control-comfort conditioning. Cabin and cargo ventilation- piping and ducting-insulating materials

**Text books:**


1) Marine Power Plants -- P.Akinov
2) Nuclear Engineering -- D.K.Singhal
3) Marine Engineering -- R.Harrington
4) Introduction to Marine Engineering -- D.A.Taylor.

## NAM 3107 Marine Thermal Lab

**Periods/week : 3** **Ses. : 50** **Exam : 50**
**Examination Practical: 3hrs.** **Credits: 1.5**

**List of experiments to be conducted:**

1. Determination of flash and fire points of oil samples - using Cleveland's apparatus
2. Determination of flash point of oil samples - using Abel's and Pensky-Martin's apparatus
3. Determination of Kinematic viscosity - using Redwood Viscometer – I & II, Saybolt's viscometer
4. Determination of calorific value of solid and liquid fuels using Bomb Calorimeter.
5. Aniline point test,
9. Calibration of pressure gauge - dead weight tester.
10. Volumetric efficiency of reciprocating air compressor.
11. Valve timing diagrams of IC engines(2 & 4 stroke engines).
12. Study of equipment to supplement theory, Boiler models,& I.C. Engine Components.
13. Experiments covering performance and other tests on Diesel Engines – Single cylinder, and Multi cylinder
14. Experiments covering performance and other tests on Petrol Engines
15 Refrigerating system and ice plant
16. Wind Tunnel

## NAM 3108 Ship Drawing - III

**Periods/week : 3** **Ses. : 50** **Exam : 50**
**Examination Theory: 3hrs.** **Credits: 1.5**

**Theory (Stability and trim)**

Transverse and longitudinal stability and trim calculations, effects of movement of liquids, cargo, fuel, fresh water, grain, rules for stability. Calculations and plotting of cross curves, G-Z curves. Stability booklet for ships, DWT scale, cargo loading and unloading, Ballasting and de-ballasting. Inclining equipment, Calculation and estimation of GM in different service conditions. Weight calculations. Introduction and importance of weight calculations in ship design and construction. Calculation of weights of plates and sections, weight calculation data. Detailed estimation of steel weight of ships hull. Calculation of LCG and VCG of ship and off-centerline moments of ship. Calculation of total weight of the ship based on group weights. Calculation of centroid of sections and plates and other structural elements.

**Practical:**

Drawing of Stability Curves, Analysis of inclining experiment and weight calculations, LCG and VCG calculation.

## B.Tech III/IV NAVAL ARCHITECTURE AND MARINE ENGINEERING
## ( II-SEMESTER )

**NAM 3201 Strength of Ships**

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

**1. Introduction to functions and analysis of ship structures**: Functions of ship structure, the forces acting up on a ship at sea, static forces, dynamic forces. The distortion of ship's structure. Application of theory and experience. Limitations of the theory. Distinction between strength and stiffness of hull girder. Forces and moments acting on ship's structures in regular waves in head seas, and oblique seas. Nature of stresses in ship's hull when ship is floating in still water and on a wave. Modeling of ship's' structures including general remarks on structural strength. Three-dimensional analysis of a ship structures (elementary treatment only). Assumptions and simplification of longitudinal strength calculations. Introduction to the use of probability theory in the assessment of longitudinal strength.

**2. Longitudinal strength of hull girder and ultimate strength:** Modeling of ship hull Girder as a beam. Assumed form of wave systems. Conditions of Hogging and Sagging. The buoyancy curve. The weight curve. Distributions of dead weight items. The Load, shearing force and bending moment curves. Characteristics of shear force and bending moment curves. Still water bending moment, wave bending moment and total bending moment. Bending theory applied to ship structures and its limitations. Calculations of hull girder section modulus and hull deflection. Dynamic effects on loads acting on the hull due to ship motions and wave action such as slamming. Thermal effects on hull girder. Stresses in the inclined condition. Application of plastic theory to ship structures, stress-strain diagram, calculation of plastic neutral axis and plastic moment. Ultimate strength of a simply supported beam and a fixed end beam. Ultimate longitudinal strength of a ship.

**3. Transverse strength of hull girder and ship hull material:** Transverse loads on ship's hull such as hydrostatic loads, weights, wave loads, racking, and torsion. Effect of hatches and other openings. Strain energy method, moment distribution method and comparison of the two methods, Influence of bracketed connections. Manufacture of steel. Requirement of ship building quality steels, high strength steels, Aluminum alloys and glass reinforced plastics.

**4. Mechanical properties and chemical composition of structural materials:** Testing of steels such as tensile test bend test and impact test. Brittle fracture. Steels for very low temperature applications.

**5. Strength of bulk heads, decks and tank tops, foundations, super structure, deck houses and structural discontinuities and local strength problem:** Types of bulkheads and loads on bulkheads. Strength analysis of bulkheads. Types of foundations - loads on foundations and Strength analysis. Generation of loads on superstructure. Factors affecting superstructure efficiency. Effective superstructure. Strength of Aluminum alloy superstructure. Strength analysis of decks and tank tops. Determination of scantlings of superstructure decks on the basis of simple bending theory. Strength of deckhouses, structural discontinuities such as holes in plates, notches in beams and girders, deck openings, ends of superstructure, ends of girders and other structural members. Stress concentration due to various structural discontinuities mentioned above. Applications of three-moment theorem to ship structures. Use of strain energy method for solution of bending moment problems and redundant structural problems.

**6. Theory of thin plates, buckling of structures, composite construction, grillage analysis, calculation of scantlings as per rules:** Thin plate theory and solution for different boundary conditions. Application of plain stress theory to ship structural problems. Case of a plate acted upon by a concentrated load; Buckling of plates. Influence of stiffeners (longitudinal and or transverse) on the buckling stress of ship's plating. Bending and membrane stresses in plates (application to bulkheads, shell plates etc.) Composite construction- Two materials with same elastic modulus. Two materials of different elastic Modulii. Bending of composite beam. Introduction to Grillage. Analysis of simple Grillage. Scantling calculations according to the rules of classification societies.

**REFERENCE BOOKS:**


1. Ship Construction by D.J.Eyres Merchant Ship Construction by D.A.Taylor
2. Principles of Naval Architecture, Vol. II by Ed.V. Lewis.

**NAM 3202 Marine Hydrodynamics**

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

**1. Small Amplitude Wave Theory Formulation and Solution:** Review of hydrodynamics-Boundary Value Problems, summary of two-dimensional periodic water wave BVP, solution of linearized water wave BVP for a horizontal bottom, dispersion equation, engineering wave properties-water particle, kinematics of progressive waves, pressure field under a standard wave, partial standing waves, energy and energy propagation in progressive waves- principle of conservation of energy. Energy Flux.

**2. Wave Forecasting:** Generation of waves-theories of wave generation by Kelvin, Phillips, Milne, Jeffrey, Swerdrup and munk. Concept of fully developed sea, Characteristics of ocean waves, significant wave height and period, wave height variability, energy spectra of waves, simplified wave prediction models-SMB and PNJ. Methods, wave forecasting charts, effects of moving storms and variable wind speed and direction.

**3. Wave Transformation and Wave statistics:** Transformation of wave entering shallow water, shoaling of waves in shallow water, wave reflection, refraction and diffraction, combined refraction, diffraction, and wave breaking. Wave Height distribution-single wave train, wave groups, narrow banded spectra, Rayleigh's distribution, wave spectrum, directional wave spectrum-JONSWAP, PNJ and Bretschneider spectra.

**4. Wave Forces:** Wave forces on vertical cylindrical bodies due to non-breaking waves – Basic concepts, calculations of forces and moments, Transverse forces due to eddy shedding (Lift forces), selection of hydrodynamic force coefficient, $C_d$ and $C_m$, calculation of forces and moments on groups of vertical and non-vertical cylindrical bodies due to breaking and non-breaking waves.

**Textbook:**

1. Shore Protection Manual, Vols. 1 & 2 by US army coastal engineering research center publication

**Reference Books:**

1. Water Wave Mechanics by Dean and Dlrymple
2. An introduction to Hydrodynamics and Water Waves by B. Le Mehaute
3. Estuary and Coastline Hydrodynamics by A.T. Ippen

**NAM 3203 Ship Design – II**

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

**1. General Arrangements of Ships:** General arrangement of ships. Layout of main and other decks. Water tight subdivision of the ships hull. Disposition of bulk heads and decks. Allocation of cargo and machinery spaces. Bridge and navigation spaces. Arrangements of tanks for fuel oil, ballast water and other liquids. Engine room layout. Cargo handling arrangement, requirement for ships. Accommodation in ships. Design philosophy of accommodation spaces. Living spaces, commissionery spaces, spaces for dining, recreation and services. Access diagrams. Design of super structure and layout. General arrangement and deck layout of general cargo ship, bulk carrier, oil tanker, container ship, passenger ship, fishing trawler, ferry, tug and dredger**.**

**2. Hull Fittings, Navigational aids and life saving appliances:** Closing devices, water tight, weather tight, gas tight and non-water tight floors. Windows and portholes. Bulkhead openings, hull openings, cargo port, bow doors, stern ramps. Man holes and access doors.

Hatch covers-weather deck and between deck. Types of hatch covers-sliding, rolling and pontoon. Operating mechanisms. Arrangements for ensuring water tightness. Life saving equipment primary and secondary types and ship requirements. Navigational equipment. Bulwarks railings and awnings, gangway, gangplanks, and gangway adders. Masts and rigging, mast designs.

**3. Auxiliary machinery and other Ship Systems:** Ship auxiliaries and equipment. Functions of auxiliary machinery and design requirements for location and installation. Selection of components and space allocation for ship systems including electrical system, Fuel and lubricating oil systems. Fresh water and sea water systems, Air conditioning, ventilation, and refrigeration systems, anchoring and mooring gear,

Steering gear types and location, automation of ship systems and ship operation. Unmanned machinery spaces.

**4. International and National regulatory Bodies:** Safety and habitability. Impact of the regulatory bodies in ship design, IMO and classification societies, SOLAS, ILLC, ITTC, MMD. Prevention of marine pollution-MARPOL regulations. Free board assignment. Stability in various operating conditions, important features of maritime law of India -regulations regarding a/c, ventilation, noise, vibrations. Survival after damage. Carriage of dangerous goods. Collision prevention.

Ship design organisation and design consideration for special ships and use of computers: Evolution of design philosophy. Changes effected over the years. The "Titatanic Disaster" and impact.

Design features of special types of ships- ice breakers, refrigerated cargo carriers, liquefied gas carriers, aircraft carriers, Ro-RO vessels, SWATH vessels, luxury passenger ships and high speed ships.

Double hull structures for tankers. Hatch coverless containers. Offshore supply vessels, deep sea fishing vessels, use of computers in design of general arrangement and systems. Trends of future developments. Aesthetic considerations in ship design.

**Reference Books:**

1. Ship Design and Construction by R.Taggart
2. Principles of Naval Architecture, Vol. 1,2&3 by Ed.V. Lewis

## NAM 3204 (A) MARINE REFRIGERATION AND AIR CONDITIONING (PEC-II)

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

**1. Thermodynamics:** Thermodynamic principles and diagrams- properties of real fluids and refrigerants – change of phase-liquid and dilute solutions-mixture of liquids – steady flow processes with binary mixtures. Properties of ideal refrigerants. Types of commercial refrigerants- cycles of refrigeration- Air cycle and steam Jet refrigeration.

**2. REFRIGERATION SYSTEMS**: Vapor compression refrigeration-cycles-Multi-pressure systems-Refrigeration components like compressors, heat exchangers and expansion devices- Controls. Vapor Absorption system- Ammonia, Electrolux, Lithium bromide systems-Applications.

**3. PSYCHROMETRY-DEFINITIONS**: Evaporative cooling of air, dehumidification and other psychometric processes-representation on psychometric chart and calculations.

**4. AIR CONDITI**ONING: Standards for marine Air conditioning-Types of air conditioning systems-Application of air conditioning systems in Cargo ships, refrigerated vessels, Passenger ships- Comfort and cargo air conditioning. Ventilation and ducting, Ship board ventilation- Engine room, Cargo holds accommodation and stores, ducting controls- Food preservation technology.

**TEXT BOOKS**:
1.Refrigeration and Air Conditioning by W.F.Stocker.
2.Refrigeration and Air Conditioning by P.L.Ballaney.

**REFERENCE BOOKS**:
1.Marine Engineering by R.L.Harington.
2. Marine Auxiliary Machinery by D.W.Smith.

## NAM 3204(B) INTRODUCTION TO OFFSHORE STRUCTURES( PEC-II )

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

Types of offshore structures and conceptual development - Analytical models for jacket structures - Materials and their behaviour under static and dynamic loads - Statutory regulations - Allowable stresses - Various design methods and Code Provisions - Design specification of API, DNV, Lloyd's and other classification societies - Construction of jacket and gravity platforms

Operational loads - Environmental loads due to wind, wave, current and buoyancy - Morison's Equation - Maximum wave force on offshore structure - Concept of Return waves - Principles of Static and dynamic analyses of fixed platforms - Use of approximate methods - Design of structural elements.

Introduction to tubular joints - Possible modes of failure - Eccentric connections and offset connections - Cylindrical and rectangular structural members – In plane and multi plane connections - Parameters of in-plane tubular joints - Kuang's formulae - Elastic stress distribution - Punching shear Stress - Overlapping braces - Stress concentration - Chord collapse and ring stiffener spacing - Stiffened tubes - External hydrostatic pressure - Fatigue of tubular joints - Fatigue behaviour - S-N curves - Palmgren-Miner cumulative damage rule - Design of tubular joints as per API Code

Analysis of offshore structures.- Fatigue analysis, inplace analysis, loadout analysis, launch analysis, transportation analysis

Corrosion - Corrosion mechanism - Types of corrosion - Offshore structure corrosion zones – Biological corrosion - Preventive measures of Corrosion - Principles of cathode protection systems - Sacrificial anode method and impressed current method – Online corrosion monitoring - Corrosion fatigue.

References

1. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.
2. API RP 2A., Planning, Designing and Constructing Fixed Offshore Platforms, API., 2000.
3. McClelland, B & Reifel, M. D., Planning & Design of fixed Offshore Platforms, Van Nostrand, 1986.
4. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.
5. Reddy, D. V & Arockiasamy, M., Offshore Structures Vol.1 & 2, Kreiger Publ. Co.1991.
6. Morgan, N., Marine Technology Reference Book, Butterworths, 1990.
7. B.C Gerwick, Jr. Construction of Marine and Offshore Structures, CRC Press, Florida, 2000.
8.Offshore pipelines by B. Gou, S. Song, J. Chacko and A. Ghalambor,Â GPP Publishers,2006

## NAM 3204 (C) Ocean Structures and Materials (PEC-II )

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

1. Brief introduction of ocean, Oil and gas resources. Near shore structures. Different types of ocean structures and systems (fixed, floating, semi-submersibles, submersibles, TLP s pipelines, intakes) for exploitation of oil and gas, minerals and energy.

2. Different materials for marine applications: Behavior of Metals, concrete and other Composite materials for marine environment. Principles of corrosion, properties and selection of materials, Non-destructive testing of materials and structures. Ocean pollution and its effect on ocean structures. Dredging and dredgers.

3.. Brief outline of planning, design and construction. Regulation and codes of practices The environment and environmental forces. Structural analysis and principles of design Foundation and sea bed anchors. Towing, launching and installation.

**References :**

1. Ben C.Gerwick, Jr., Construction of Marine and Offshore Structures, CRC Press, New York, 2000
2. Reddy, D.V.and Arockiasamy, M., Editors, Offshore Structures, Vol.I and II, Krieger Publishing Company, Florida, 1991
3. Per Bruun, Port Engineering, Volume I and II, Gulf Publishing Company, 1989

**NAM 3205 Marine Manufacturing Technology**

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

**1. Foundry:** Foundry tools and appliances, layout – pattern types, materials, allowances, pattern making, moulding sands, types. Moulding methods, equipment for moulding, casting methods.
**2. Lathe:** Working principle, classification, specification, different operations on a lathe, methods of taper turning, cutting speed, feed, depth of cut, machining time and power required for cutting. Turret and capstan lathes.
**3. Shaper and Planer (Elementary Treatment only):** Principal parts, classification – quick return mechanisms, table feed mechanism working on shaper and planer, a comparison. Work holding devices.
**4. Drilling and Boring Machines (Elementary Treatment only):** Classification, specifications, cutting speed, feed, machining times, parts and description of boring machines, types.
**5. Linear and angular measurements:** Micrometers, Slip gauges, Vernier and optical bevel Protractors, sine bar Angle gauges.
**6. Comparators:** Types, Mechanical, Electrical, Electronic comparators.
**7. Grinding:** Introduction-abrasives-grinding wheels, bonding processes, selection of grinding wheels-grinding machines-classification-honing-lapping, super-finishing, buffing, polishing, selection of process parameters.

**Textbooks:**

1. Engineering Metrology by R.K. Jain
2. Production Technology by R.K. Jain and S.C. Gupta

**References:**

1.Production Technology by P.C. Sharma
2.Workshop Technology, Vol.1, 2&3 by W.A.J. Chapman
3.Machine Tools by Bhattacharya

**NAM 3206 Computer Aided Ship Design**

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

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 3207 - MARINE INSTRUMENTATION&METROLOGY LABORATORY**

**Periods/week: 3** **Ses. : 50** **Exam: 50**
**Examination Practical: 3hrs** **Credits: 1.5**

**Metrology experiments**

- Calibration of mechanical comparator
- Calibration of Micrometer
- Testing of Concentricity trueness and parallelism of a mandrel
- Measurements of taper bar using Dial gauge, bevel protractor and sine bar.
- Distance between two holes of a template using Vernier height gauge.
- Measuring the central height of a circular spigot
- Measuring the pitch diameter, diametral pitch and pressure angle of an involute spur gear
- Study of flatness of slip gauges using optical flats and monochromatic light.
- Calibration of Vernier calipers.
- Calibration of Vernier Height gauge

Instrumentation experiments

- Calibration of thermocouple, thermisiters.
- Calibration of force and stresses using strain gauges.
- Flow rate measurement and roto meter.

.Calibration of pressure gauge.

**NAM 3208 Computer Aided Ship Design Lab**

**Periods/week: 3** **Ses : 50** **Exam: 50**
**Examination Theory: 3hrs.** **Credits: 1.5**

**2-D and 3-D Structural Problems:**
Modelling, Meshing and solving using FEM packages. CAD techniques to finite element data preparation- Automatic mesh generation- presentation of results - 3-dimensional shape description and mesh generation- CAD applications of FEM.

**CASD (Computer Aided Ship Design)**
Exposure to CASD packages like Rhino, NAPA, TRIBON, Shipflow etc: Application to ship design, CAD applications in ship building. Simple examples of computer aided drafting, design and analysis of ships. Lines Plan, fairing of lines using Rhino/NAPA, Hydrostatic Curves, Stability using NAPA software

**DEPARTMENT OF MARINE ENGINEERING**
**Proposed Scheme of Instruction and Examination**
**B.Tech (NAVAL ARCHITECTURE AND MARINE ENGINEERING)**
**Effective Admitted Batch 2019-20**

**IV / IV First semester**

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 4101 | Sea Keeping and Maneuverability | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4102 | Ship Structural Design and Vibrations | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4103 | **PEC - III**<br>a. FVT<br>b. Design of Small crafts<br>c. Naval Vessels | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4104 | Marine Instrumentation and Control | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4105 | Engineering Economics (HSMC -I) | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4106 | Ship Hydrodynamics Laboratory | | | 3 | 3 | 50 | 50 | 100 | 1.5 |
| NAM 4107 | Project-I | -- | -- | 6 | -- | 50 | 50 | 100 | 5 |
| TOTAL | | *29* | | | *18* | *250* | *450* | *700* | *21.5* |

*IV / IV Second semester*

| Code No | Subject | Periods | | | Exam Hours | Sessionals | Exam Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | | | | |
| NAM 4201 | **PEC-IV:**<br>a. Dynamics of Offshore structures<br>b. Marine Diesel Engines<br>c. Underwater Acoustics | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4202 | **PEC - V**<br>a. Advanced Welding Technology<br>b. Advanced Ship Systems<br>c. Marine Pollution | 3 | 1 | -- | 3 | 30 | 70 | 100 | 3 |
| NAM 4203 | Project II | -- | -- | 20 | -- | 50 | 50 | 100 | 10 |
| TOTAL | | 28 | | | 6 | 110 | 190 | 300 | 16 |

## B.Tech IV/IV NAVAL ARCHITECTURE AND MARINE ENGINEERING
## ( I-SEMESTER )

**NAM 4101 Sea Keeping and Maneuverability**

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

1. Introduction to sea keeping: Importance of sea keeping analysis. Behaviour of a ship in a seaway. Regular waves, Sinusoidal and trochoidal Theories.Chacteristics 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 manoeuvers. Heel while turning. Manoeuvering 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 form hydrodynamic derivatives.

References:

1.Dynamics of Marine Vehicles by Rameshwar Bhattacharya.
2.Principles of Naval Architecture, Vol. III by Ed.V. Lewis

**NAM 4102 Ship Structural Design and Vibrations**

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

**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, emprical 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. Eyers
3. Principles of Naval Architecture by Ed.V. Lewis
**4. Ship Design and Construction by R.Taggart**

## NAM 4103 (A) FISHING VESSELS TECHNOLOGY(PEC-III)

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

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 4103 - (B) DESIGN OF SMALL CRAFTS (PEC –III)

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

**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 4103 (C)NAVAL VESSELS ( PEC –III)**

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

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

**NAM 4104 Marine Instrumentation and Control**

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

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 4105 Engineering Economics (HSMC-I)

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

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:
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 4106 SHIP HYDRODYNAMICS LABORATORY

**Periods/week :3** **Ses. : 50** **Exam : 50**
**Examination Practical: 3hrs.** **Credits: 1.5**

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.

# B.Tech IV/IV NAVAL ARCHITECTURE AND MARINE ENGINEERING (II-SEMESTER)

## NAM 4201 –(A) Dynamics of Offshore Structures (PEC – IV)

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

**Module 1 (9 hours)**
A Dynamic perspective.Introduction to different types of ocean structures.Development of structural forms for deep and ultra deep waters.Basis of structural design of ocean structures.Environmental forces.Structural dynamics.Basics-SDOF systems Fundamentals of structural dynamics.Mathematical modeling of structural systems.Single Degree of Freedom (SDOF) systems. Characteristics of sing degree of freedom model – formulation of equation of motion. Free and Forced vibration of single degree of freedom systems.Undamped and damped systems.

**Module 2 (14 hours)**
Structures in the offshore environment - Description of typical offshore structures – Fixed- Compliant-Floating - Solid fluid interaction parameters - Spring factor - Added massand damping Response of offshore structures - Modeling of offshore structures – single and multi-degree freedom systems – effect of foundations

**Module 3 (12 hours)**
Structural action of ocean structures - Multi-Degree of freedom (MDOF) systems. Formulation of equation of motion - Influence coefficients - Eigen value problems. Dynamic matrix method. Dunkerley's method - Matrix iteration method - Stodla's method.Mode superposition.Mode truncation.Rayleigh-Ritz method.Damping.Rayleigh damping – Caughey damping. Application of dynamics.Fluid structure interaction (FSI).Perforated members.Articulated tower (AT).Freely moving structures - Stability of submerged and floating structures - Stability at small and large angles

**Module 4 (10 hours)**
Experimental Structural Dynamics. Experimental studies-free floating studies-free decay studies. Experimental investigation on perforated cylinders & perforated TLP model.Structural dynamics, introduction to stochastic dynamics of ocean structures.Motion analysis in random waves - Low frequency oscillation.Dynamic positioning.

**Module 5 (6 hours)**
Stochastic Dynamics – Introduction to Stochastic Dynamics of ocean structures. Fatigue Prediction.Random Environmental Processes – Response Spectrum.

**References**
1. Wilson, J. F., Dynamics of Offshore Structures, John Wiley, 2002.
2. Clauss, G, Lehmann, E &Ostergaard, C., Offshore structures - Vols 1 & 2, SpringerVerlag, 1992.
3. Chakraborti, S. K., Non Linear methods in Offshore Engineering, Elsevier SciencePubl, .2002.
4. Hooft, J. P., Advanced Dynamics of Marine Vehicles, John Wiley, 1982.

**NAM 4201 (B) MARINE DIESEL ENGINES( PEC – IV)**

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

**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 detectors, 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 4201 (C) UNDERWATER ACOUSTICS (PEC – IV)**

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

**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, Beam formers, 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 fi-equency, 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 4202 (A) ADVANCED WELDING TECHNOLOGY ( PEC – V)**

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

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 4202 (B) Advanced Ship Systems (PEC – V)

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

**Ship systems**: Introduction, Ship system formulations, main and auxiliary systems. Arrangement of machinery, piping diagrams.
Fuel system, Steam and condensate system, Automation systems.central cooling and central priming systems, control and service air system, domestic fresh water and sea water service system, drinking water system, fire main system. Fire detection and extinction systems, pumping systems on board such as bilge, ballast and cargo pumping operations, refrigeration system, and sewage system.
**System Components:** viz. Pumps, piping and valves in the various systems- their construction, operation and maintenance.
**Operation systems**: Steering system, shafting system, main propulsion system, navigation systems, Anchoring and mooring systems - systems – operation, construction, care and maintenance
**Powergeneration and distribution systems**:generators, switchboards and panels, lighting and power distribution.

**Heating, Ventilation and Air Conditioning systems**: Psychometrics, heating load, cooling load, comfort, ventilation and room air distribution. Humidifying and dehumidifying, ducting and piping and their components and construction, ventilation system and venting system for cargo holds, tankers and accommodation.
**Helideck systems and Armament systems**- construction and operation
**Lifesaving systems** - Use of survival equipment – Survival craft and rescue boat. Primary and secondary types of life saving equipments.

TEXT BOOKS:
1. D.W. Smith, “Marine Auxillary Machinery”, 6th Edition, Butter worths, London, 1987.
2. H.D. McGeorge, “Marine Auxillary Machinery”, 7th Edition, Butter worth, London,2001.
3. Introduction to marine engg – D.A. Taylor – Butter worth- Heinemann

REFERENCE:
1. H.D. McGeorge, “General Engineering Knowledge”, 3rd edition, Butter worth – Heineman, London, 1991.
2. Victory, “Fire Fighting Equipment And Its Use In Ships”, Marine Engineering Practice, Vol 1, Part 05, IMarEST, London

**NAM 4202 (C) Marine Pollution (PEC – V)**

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

**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.