## B.E III/IV SEMESTER – I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>COURSE</th>
<th>Periods (L/T/Lab)</th>
<th>Exam (hours)</th>
<th>Sessional Marks</th>
<th>Exam Marks</th>
<th>Total Marks</th>
<th>Credits</th>
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<tbody>
<tr>
<td>NAM 311</td>
<td>Industrial Electronics</td>
<td>5</td>
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<td>NAM 312</td>
<td>Fluid Mechanics</td>
<td>5</td>
<td>3</td>
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<td>Ship Design - I</td>
<td>5</td>
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<td>NAM 314</td>
<td>Marine Machinery – I</td>
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<td>NAM 315</td>
<td>Resistance &amp; Propulsion</td>
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<td>NAM 316</td>
<td>Elective-I</td>
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<td>*NAM 317</td>
<td>Soft Skills Lab</td>
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*Common with Mechanical Engineering.

# For other department students

## B.E III/IV SEMESTER - II

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>COURSE</th>
<th>Periods (L/T/Lab)</th>
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<td>Manufacturing Technology</td>
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<td>NAM 322</td>
<td>Strength of Ships</td>
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<td>Marine Hydrodynamics</td>
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<td>NAM 324</td>
<td>Ship Design - II</td>
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<td>NAM 325</td>
<td>Elective-II, Off-shore structures, Marine power plant engineering.</td>
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<tr>
<td>NAM 326</td>
<td>Ship Construction</td>
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<td>Ship Drawing - III</td>
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3 weeks Industrial training during summer vacation after 3rd year 2nd semester. Submission of report and presentation in 4th year 1st semester.
**B.E. - III/IV NAVAL ARCHITECTURE**  
** ( I-SEMESTER )**

**NAM 311 - INDUSTRIAL ELECTRONICS**  
(Common with Mechanical Engineering)

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

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).

**References:**
3. Industrial Electronics by Bhattacharya, Tata Mc-Graw Hill.
NAM 312 – FLUID MECHANICS

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

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.
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.
6. Boundary Layer Flow: Laminar Boundary Layer- turbulent layer and Laminar sub-layer – Boundary layer thickness ($\delta$) – displacement thickness ($\delta^*$) and momentum thickness – energy thickness ($\delta^{**}$) - 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


**References:** 1. foundations of fluid Mechanics, by Yuan, prentice Hall of India


NAM 313- Ship Design - I

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

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
3. Principles of Naval Architecture, Vol. 1,2&3 by Ed.V. Lewis
NAM 314 – MARINE MACHINERY - I

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

1. Marine and Special duty pumps: 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. Ejectors and their purpose. Applications in Marine use. Details of construction.

2. 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.

3. Marine systems: Evaporators, distillers, waste heat recovery systems. Hot water, drinking water, cooling water (fresh water) and sea water systems. Fuel systems, lubricating oil systems, strainers and filters, coolers, centrifuges, purifiers and clarifiers. Bilge and Ballast systems- sewage’s disposal system.

4. 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.
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.


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:**
NAM 316 - ELECTIVE – I
(A) FINITE ELEMENT ANALYSIS

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


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


**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.
NAM 316 - ELECTIVE – I
(B) Computer Graphics

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

Examination Theory: 3hrs.  
Credits: 4

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:
2. Graphics fundamentals by Shirley
3. 1CG mathematics by Lengye.

References:
NAM 316 - ELECTIVE – I  
(C) WORK STUDY

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

1. Introduction to work study- Scientific management- Productivity. Advantages of work study to management, Supervisors and workers.


Job Evaluation- Techniques of job evaluation- Merit rating- Incentive plans. Activity sampling- Its application

Text Books:
1. Introduction to Work Study-International Labour Organisation.

Reference:
Motion and Time Study, by Barnes, John Wiely.
NAM 316 - ELECTIVE –I
(D) MARINE REFRIGERATION AND AIR CONDITIONING

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


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 CONDITIONING:** 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.

**REFERENCE BOOKS:**
FREE ELECTIVE
(Offered to other branch students)

POWER PLANT ENGINEERING

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

Credits: 4


Internal Combustion Power Plants: Types of engines for power generation, Super charging, Exhaust heating fuel tanks and oil supply systems. Air supply for starting, Modern trends and design in diesel engines, Performance of engines.


Hydro Electric Plants: Different types of plants. Selection of site. Low, medium and high head plants and pumped storage plants. General layout of the plant – Head works, Spillways, Canals, Tunnels, Governing, Lubrication, Penstock, Anchorages and relief valves, different types of surge tanks, intakes, Gates and Valves.

Nuclear Power Plants: Classification of reactors, Thermal utilization, Fuels, Fuel moderator and coolant, Control and safety rods, Special properties of structural materials required, Induced radioactivity, Gas cooled reactors, Radiation hazards and shielding, Radio active waste disposal.


Text Books:

References:
3. Modern Power Plant Engineering by Joel Weisman, Roy Eckart, PHI.
*** NAM 317 SOFT SKILLS LABORATORY

Periods/week : 3        Credits: 1

(Common for all Branches of Engineering)

1. Basic Skills
   - Listening
   - Speaking
   - Reading
   - Writing

2. Non-Verbal
   - Grooming(Personal Appearance)
   - Using space
   - Body Language
   - Paralanguage

3. Basic Etiquette
   - Introducing
   - Conversation-Small Talk
   - Table Manners
   - Telephone/Cell phone manners

4. Goal setting
   - Immediate,Short term,Long term
   - Smart Goals
   - Strategies to achieve goals

5. Time-Management
   - Types of time
   - Identifying time wasters
   - Time Management Skills

6. Using Telephone
   - Making and receiving calls
   - Handling wrong numbers and unnecessary calls
   - Intonation
   - Enunciation

7. Leadership and Team Management
   - Qualities of good leader
   - Leadership styles
   - Decision Making
   - Problem Solving
   - Negotiation Skills

8. Assertiveness
   - Assertiveness and aggressiveness
   - Disagreement
• Openness and Expressiveness
• Self Concept
• Positive thinking

9. Group Discussion
• Purpose (Intellectual ability, Creativity, Approach to a Problem, Solving, Tolerance, Qualities of a leader)
• Group Behaviour
• Analysing Performance

10. Job Interview
• Identifying Job Openings.
• Preparing a Resume (Basic, Functional, Specific).
• Covering Letter (Solicited/Unsolicited)
• Interview (Opening, Body-Answer Q, Close-Ask Q).
• Types of questions.
• Handling difficult Questions.

REFERENCE BOOKS:

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. **Power Press:** Operation, components, classification, selection, cutting dies, power requirements, power press operations, punching, blanking, deep drawing.

6. **Linear and angular measurements:** Micrometers, Slip gauges, Vernier and optical bevel Protractors, sine bar Angle gauges.

7. **Comparators:** Types, Mechanical, Electrical, Electronic comparators. Measurement of Straightness- flatness- squareness and symmetry- parallelism and circularity.

8. **Metrology:** Metrology of screw threads and Metrology of gears (Measurement of Pitch and tooth thickness only).


**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
1. **Introduction to functions and analysis of ship structures:** Functions of ship structure, the forces acting upon 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 Hoggimg 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 ended 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.


Scantling calculations according to the rules of classification societies.

REFERENCE BOOKS:
1. Ship Construction by D.J.Eyres
2. Merchant Ship Construction by D.A.Taylor
NAM 323 - MARINE HYDRODYNAMICS

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


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:
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


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.

Ship design organisation and design consideration for special ships and use of computers: Evolution of design philosophy. Changes effected over the years. The “Titanic 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.

Reference Books:
1. Ship Design and Construction by R.Taggart
2. Principles of Naval Architecture, Vol. 1,2&3 by Ed.V. Lewis
NAM 325- ELECTIVE –II
(A) MARINE POWER PLANT ENGINEERING

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


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.


**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.
Module 1
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

Module 2
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.

Module 3
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

Module 4
Analysis of offshore structures.- Fatigue analysis, inplace analysis, loadout analysis, launch analysis, transportation analysis

Module 5
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
NAM 325 – ELECTIVE –I I  
(C) Ocean Structures and Materials

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

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.


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 :

NAM 325 - ELECTIVE – I I
(D) OPERATIONS RESEARCH

Periods/week : 5
Ses. : 30
Exam : 70
Examination Theory: 3hrs.
Credits: 4
(Common with Mechanical (with Marine Engg. Electives))

1. **Development**: Definition, Characteristics and phase of Scientific Method, Types of models. General methods for solving operations research models.

2. **Allocation**: Introduction to linear programming formulation, graphical solution, Simplex method, Artificial variable technique, Duality theory and Dual simplex method.

3. **Transportation Problem**: Formulation optimal solution. Unbalanced transportation problems, Degeneracy. Assignment problem, Formulation optimal solution, Variations i.e., Non-square (m*n) matrix restrictions.

4. **Sequencing**: Introduction, Terminology, notations and assumptions, problems with n-jobs and two machines, optimal sequence algorithm, problems with n-jobs and three machines, problems with n-jobs and m-machines, graphic solutions. Travelling salesman problem.

5. **Waiting lines**: Single channel Poisson arrivals, Exponential service times, Unrestricted queue with infinite population and finite population models; Single channel Poisson arrivals, Exponential service times with infinite population and restricted queue.

6. **Replacement**: Introduction, Replacement of items that deteriorate with time - value of money unchanging and changing, Replacement of items that fail completely.


8. **Inventory**: Introduction, inventory costs, Independent demand systems: Deterministic models - Fixed order size systems - Economic order quantity (EOQ) - Single items, back ordering, Quantity discounts (all units quantity discounts), Batch - type production systems: Economic production quantity - Single items, Economic production quantity multiple items. Fixed order interval systems: Economic order interval (EOI) - Single items, Economic order interval (EOI) - Multiple items.

9. **Network Analysis**: Network definitions, Minimum spanning tree algorithm, Shortest root problem, Maximum flow model. Elements of project scheduling by CPM and PERT.

**Text Books**:
1. Operation Research, by TAHA (PHI)
3. Operation Research by S.D.Sharma.(Kedarnadh Ramnadh & Co.,)
4. Operation Research by R.Pannerselvam, (PHI)
NAM 326 - SHIP CONSTRUCTION

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

**Introduction to ship building and materials used:**

**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 aftend 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:**

**References:**
NAE 327 - SHIP DRAWING - II

Periods/week : 6   Ses. : 100
Credits: 4

**Resistance:** Resistance, powering and propulsion calculations, propeller design and drawing, rudder design and drawing.

**Practical:** Resistance calculations using Guldhammer and Harvald method, and plotting of resistance and propulsion curves. Propeller design and drawing, rudder design and drawing.

**Strength of Ships:** Strength of ships and structural design based on longitudinal strength and transverse strength calculations. Midship section design and drawing, derrick design and drawing, drawing of trochoidal wave and sine wave. Use and application of classification rules. Bulkhead design and drawing. Deck design and drawing.

**Practical:** Drawing of shell expansion plan, mid ship section, steel weight calculations, longitudinal strength calculations, transverse strength calculations, derrick design.

**INDUSTRIAL TRAINING**

3 weeks Industrial training during summer vacation after 3\textsuperscript{rd} year 2\textsuperscript{nd} semester. Submission of report and presentation in 4\textsuperscript{th} year 1\textsuperscript{st} semester.