DEPARTMENT OF MARINE ENGINEERING
Proposed Scheme of Instruction and Examination
B.Tech (NAVAL ARCHITECTURE AND MARINE ENGINEERING)
Effective Admitted Batch 2020-21
III / IV First semester

Course code	Category	Course Title	Hours per week		Int Marks	Ext Marks	Total Marks	Credits
			L	P				
NM 3101	PC	Fluid Mechanics	4	0	30	70	100	3
NM 3102	PC	Ship Design - I	4	0	30	70	100	3
NM 3103	PC	Ship Construction	4	0	30	70	100	3
NM 3104	OE	Industrial Electronics	4	0	30	70	100	3
NM 3105	PE	Intro to Offshore str Ocean Strs & mat FEA	4	0	30	70	100	3
NM 3106	PC	Marine Thermal Lab	0	3	50	50	100	1.5
NM 3107	PC	Mech of Materials Lab	0	3	50	50	100	1.5
NM 3108	SC	Skill advanced course	1	2	50	50	100	2
NM 3109	MC	Industrial Solid waste Utilization	0	0	0	0	0	0
Summer Internship 2 Months (Mandatory) after second year (to be evaluated during Semester - V								2
Total credits								**22**

B. Tech -III Year- II Semester

Course code	Category	Course Title	Hours per week		Int Marks	Ext Marks	Total Marks	Credits
			L	P				
NM 3201	PC	Resistance and Propulsion	4	0	30	70	100	3
NM 3202	PC	Strength of Ships	4	0	30	70	100	3
NM 3203	PC	Ship Design - II	4	0	30	70	100	3
NM 3204	PE	Marine Manufacturing Technology FVT	4	0	30	70	100	3
NM 3205	OE	NAPA /Rhino /Exact Flat Lab	4	2	30	70	100	3
NM 3206	PC Lab	Marine Hydrodynamics Lab	0	3	30	70	100	1.5
NM 3207	PC Lab	Marine Instrumentation and Metrology lab	0	3	50	50	100	1.5
NM 3208	PC Lab	Ship Drawing - III	0	3	50	50	100	1.5
NM 3209	SC	Skill advanced course	1	2	50	50	100	2
NM 3210	MC							
Total credits								**21.5**
Industrial/Research Internship (Mandatory) 2 Months during summer vacation								

B. Tech -IV Year- I Semester

Course code	Category	Course Title	Hours per week		Int Marks	Ext Marks	Total Marks	Credits
			L	P				
NM 4101	PE	Marine Hydrodynamics Advanced Welding Tech	4	0	30	70	100	3
NM 4102	PE	sea keeping and manoeuvrability Dyn of Offshore Structures	4	0	30	70	100	3
NM 4103	PE	Diesel of Small Crafts Naval Vessels	4	0	30	70	100	3
NM 4104	OE	Marine Instrumentation and Control Ship Vibrations	4	0	30	70	100	3
NM 4105	OE	CASD Underwater Acoustics	4	0	30	70	100	3
NM 4106	HSS	Industrial Engineering and management	4	0	30	70	100	3
NM 4107	SC	Skill advanced course	1	2	50	50	100	2
Summer Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester								2
Total credits								**22**

B. Tech -IV Year- II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
NM 4201	Major Project	Project work, seminar and internship in industry	0	0	-	100	100	14
Internship (6 Months)								
Total credits								**14**

NM 3101 FLUID MECHANICS

Course Objectives: This course offers basic knowledge on fluid statics, dynamics and hydraulic machines. The objective of this course is to enable the student to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery.

Course Outcomes: The student will be able to:

- Identify importance of various fluid properties at rest and in transit.
- derive and apply general governing equations for various fluid flows
- Understand the concept of boundary layer theory and flow separation.
- Plot velocity and pressure profiles for any given fluid flow.
- evaluate the performance characteristics of hydraulic turbines and pumps

SYLLABUS

NM 3101– FLUID MECHANICS

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

Examination Theory: 3hrs. Credits: 4

Properties of fluids- Viscosity- Pressure measurement and Manometers- Hydrostatic forces on surfaces.

Fluid Kinematics & Fluid Dynamics: Stream line- Stream tube- Stream function- Potential function- Classification of flows- Steady, Unsteady, Uniform, Non-uniform, Laminar, Turbulent, Rotational, Irrotational flows, Vorticity and circulation- Conservation of mass- Equation of continuity, Conservation of momentum- Euler's equation, Conservation of energy- Bernoulli's equation and its applications- Vortex motion- Free and forced vortices- Basic solutions of ideal fluid flows- Flow net analysis.

One dimensional Viscous Flow: Couette flow- Plane Couette flow, Favourable pressure gradient and adverse pressure gradient- Flow through pipes- Hagen Poiseulle flow- Fannigs friction factor- Darcy's Weisbach friction factor- Loss of head due to friction in pipes- Laminar and turbulent regimes- Flow potential and flow resistance- Flow through branched pipes, Momentum equation- Forces due to pipe bends, Curved tubes, Sudden enlargement, Sudden contraction, flow through porous media- Darcy's equation. Two dimensional viscous flow: Navier -Stokes equations and solutions- Order of magnitude analysis- Boundary layer equations. **Laminar Boundary Layer:** Momentum integral equation- Flow over a flat plate- Displacement thickness, Momentum thickness and energy thickness.

Turbulent Boundary Layer: Laminar- Turbulent transition- Momentum equations and Reynold's stresses- Fully developed turbulent flow through a pipe- Turbulent boundary layer on a flat plate- Laminar sub-layer- Boundary layer separation and control.

Dimensional Analysis and Modeling Similitude: Fundamental and derived dimensions- Dimensionless groups- Buckingham p-theorem- Rayleigh method- Model testing- Types of similarity- Geometric, Kinematic and Dynamic similarities- Hydraulic diameter.

Compressible Fluid Flow: Thermodynamic relations- Continuity, Momentum and Energy equations- Velocity of sound in a compressible fluid- Mach number and its significance- Limits of incompressibility- Pressure field due to a moving source of disturbance- Propagation of pressure waves in a compressible fluids- Stagnation properties- Stagnation pressure, Temperature and density- Area velocity relationship for compressible flow- Flow of compressible fluid through nozzles- Condition for maximum discharge through nozzles- Variation of mass flow with pressure ratio- Compressible flow through a venturimeter- Pitot static tube in a compressible flow.

Text Book:

Fluid Mechanics, by A.K.Mohanty, Prentice Hall of India Pvt.Ltd.

References:

1. Fluid Mechanics and Hydraulic Machines, by R.K.Bansal, Laxmi publications.
2. Foundations of Fluid Mechanics, by Yuan, Prentice Hall of India.
3. Fluid Mechanics and its Applications, by S.K.Gupta and A.K.Gupta, Tata McGraw Hill, New Delhi.
4. Fluid Mechanics and Hydraulic Machines by R.K.Rajput, S.Chand & Co.
5. Fluid Mechanics by Kothandaraman and Rudramoorthy.

NM 3102 SHIP DESIGN-I

Course objectives: introducing basic ship theory, the ship design process, and systems engineering concepts. Hands on development of a computer code for ship hydrostatics analysis. Hands on experiments on ship stability and resistance. Visits and exercises on board ships. Individual ship design project and related workshops.

Course outcome:

This course gives an introduction to naval architecture, i.e. the engineering design of ships and other marine technology systems, and basic ship theory such as hydrostatics, stability, resistance and propulsion. The objective is that students after finishing the course shall be able to:

- Demonstrate knowledge and understanding of the scientific basis and proven experience of ship design and insight into current research and development work;
- Demonstrate methodological knowledge and understanding in ship hydrostatics, stability, resistance and propulsion;
- Demonstrate ability to model, simulate, predict and evaluate ships' hydrostatics, stability, resistance, and energy and resource efficiency, even on the basis of limited information;
- Demonstrate ability to critically, independently and creatively make the initial design of a ship for a certain transport scenario, taking into account relevant scientific, social, ethical, economic and environmental aspects, and international regulatory frameworks;
- Give an account of the international shipping markets and the corresponding stakeholders, goods flow paths, and ship types;
- Discuss the opportunities for seaborne transportation in a sustainable society and describe the shipping-related environmental problems and measures for tackling them;
- Demonstrate ability to plan and carry out advanced engineering tasks within given frames using appropriate methods and to evaluate this work;
- Demonstrate ability to clearly present and discuss engineering conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts.

Syllabus

NM 3102SHIP DESIGN - I

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

Examination Theory: 3hrs. Credits: 4

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.

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.

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.

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.

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

NM 3103SHIP CONSTRUCTION

Course Objective:

• To be well versed in how to apply various knowledge of architecture on ship operations.

• To Understand Ship Stability and Statically Stability

Course Outcome:

- CO 01: To understand the types of Ships
- CO 02: To understand the Stress and Strain in Ships in Still water and in Sea way
- CO 03: To understand the principle part of Ships
- CO 04: To understand the advantages of welding over riveting
- CO 05: To understand the concept of law of floatation
- CO 06: To understand the center of buoyancy and factors affecting the same
- CO 07: To understand the Transverse Statically stability
- CO 08: To understand the Equilibrium of Ship
- CO 09: To calculate of List while Loading, Discharging and/or shifting weights, Correction of List
- CO 10: To understand how to use of hydrostatic tables and curves as supplied to ships, Displacement/draft-curve and table, Light displacement& Load displacement

Syllabus

NM 3103- SHIP CONSTRUCTION

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

Examination Theory: 3hrs. Credits: 4

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 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:

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

Syllabus

NM 3104 - Industrial Electronics (OEC)

Periods/week: 4 Ses. : 30 Exam: 70

Examination Theory: 3hrs. Credits: 3

Devices: Semi-conductor diode, Zenor diode - Transistor - Silicon control rectifier.

Rectifiers, Amplifiers, Oscillators, Cathode ray oscilloscope.

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.

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

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.

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.

NM 3105 (A) INTRODUCTION TO OFFSHORE STRUCTURES

Course Objectives: This subject introduces students to basic naval architectural knowledge e.g. naval architectural terms, ship components and simple hydrostatics calculations. It also enables students to familiarize themselves with various offshore engineering sectors including basic knowledge on types of offshore structures and their functions

Course outcomes:

On successful completion of this unit, students should be able to:

- Appreciate the shipbuilding industry
- Acquire the naval architectural principles and concepts
- Use the methods of numerical integration and quadrature
- Describe in detail a number of different offshore facility concepts, including the advantages and
- Disadvantages of each understand the various types of fixed and floating offshore platforms, including key design, fabrication
- And installation issues, as well as areas of applicability describe in detail a number of ships from recreational to naval, small to big, operating on or under the
- Sea acquire the basic knowledge of mooring systems and subsea technology

Syllabus

NM 3105(A)
INTRODUCTION TO OFFSHORE STRUCTURES

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

Fundamentals of physical oceanography, drilling technology, mooring systems, study of Environmental forces i.e. waves, wind, tides and current. Types of drilling rig suitability for particular applications. Drill ship- special equipment and operation of drilling rigs- supply crafts, structural arrangements, and semi-submersibles. Various types of offshore structures- jacket platforms, gravity platforms, complaint structures- guyed tower, tension leg platform etc. Structural systems used. Load calculation- wave, wind, current and functional loads, Soil structure interaction. Analysis of offshore structural components matrix methods-plane frame, grid and space frames. Introduction to dynamic analysis, transportation, launching and upending problems, preliminary design aspects of offshore structures. Safety and reliability of offshore structures.

REFERENCE BOOKS:

1. Hydrodynamics of Offshore Structures by S.K.Chakravarthy

2. Offshore Structural Engineering by Thomas H.Dawson
3. Mechanics of Wave Forces on Offshore Structures by Turgut Sarpkaya & M. Isaacson.

NM 3105 (B) FINITE ELEMENT ANALYSIS

Course Objective:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems

Course Outcomes: At the end of the course, a student will be able to

- CO1: apply direct stiffness, Rayleigh-Ritz, Galerkin method to solve engineering problems and outline the requirements for convergence.
- CO2: analyze linear 1D problems like bars and trusses; 2D structural problems using CST element and analyse the axi-symmetric problems with triangular elements.
- CO3: write shape functions for 4 and 8 node quadrilateral, 6 node triangle elements and apply numerical integration to solve; 1D and 2D; stiffness integrations.
- CO4: solve linear 2D structural beams and frames problems; 1Dheat conduction and convection heat transfer problems.
- CO5: evaluate the Eigenvalues and Eigenvectors for stepped bar and beam, explain nonlinear geometric and material non linearity

Syllabus

NM 3105 (B) FINITE ELEMENT ANALYSIS

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

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.

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.

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

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

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.

NM 3106 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,
6. Calibration of pressure gauge - dead weight tester.
7. Volumetric efficiency of reciprocating air compressor.
8. Valve timing diagrams of IC engines(2 & 4 stroke engines).
9. Study of equipment to supplement theory, Boiler models,& I.C. Engine Components.
10. Experiments covering performance and other tests on Diesel Engines – Single cylinder, and Multi cylinder
11. Experiments covering performance and other tests on Petrol Engines
12. Refrigerating system and ice plant
13. Wind Tunnel

NM 3107 – MECHANICS OF MATERIALS LAB

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 using Hounsefield Tensometer.

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 Hounsefield tensometer.

12. Sieve Analysis and determination of fineness number.

NM 3108 (SC) SKILLED DEVELOPMENT COURSE

NM 3109 (MC) INDUSTRIAL SOLID WASTE UTILIZATION

B. Tech -III Year- II Semester

Course code	Category	Course Title	Hours per week		Int Marks	Ext Marks	Total Marks	Credits
			L	P				
NM 3201	PC	Resistance and Propulsion	4	0	30	70	100	3
NM 3202	PC	Strength of Ships	4	0	30	70	100	3
NM 3203	PC	Ship Design - II	4	0	30	70	100	3
NM 3204	PE	Marine Manufacturing Technology FVT	4	0	30	70	100	3
NM 3205	OE	NAPA /Rhino /Exact Flat Lab	2	2	30	70	100	3
NM 3206	PC Lab	Marine Hydrodynamics Lab	0	3	30	70	100	1.5
NM 3207	PC Lab	Marine Instrumentation and Metrology lab	0	3	50	50	100	1.5
NM 3208	PC Lab	Ship Drawing - III	0	3	50	50	100	1.5
NM 3209	SC	Skill advanced course	1	2	50	50	100	2
NM 3210	MC							
Total credits								**21.5**
Industrial/Research Internship (Mandatory) 2 Months during summer vacation								

NM 3201 Resistance & Propulsion

Course Objectives:

Students undergoing this course are expected:

- To understand and analyze the gas turbine engine and its components.
- To realize and analyze the thermodynamics of various component of a gas turbine engine.

Course Outcomes:

- Apply the working concept of various types of gas turbine engines in practical applications
- Differentiate between a subsonic and a supersonic inlet and further relate it to aerospace applications.
- Analyze the working concept of various types of compressors.
- Illustrate the operational and designing concepts of gas turbine blades.
- Examine the suitability of the combustion chamber & nozzle for a given gas turbine engine

SYLLABUS

NM 3201 - RESISTANCE AND PROPULSION

Periods/week : 4 Ses. : 30 Exam : 70

Examination Theory: 3hrs. Credits: 4

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.

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.

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.

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.

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 $B\rho$- δ 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.

NM 3202STRENGTH OF SHIPS

Course objective:

The course objective is to provide students with the knowledge and application skills to meet the knowledge, understanding, and practical assessment requirements for ship construction and stability as part of the requirements for an officer in charge of the navigational watch.

Course Outcomes:

- Determine whether stresses on the ship are within the permitted limits by use of stress data
- Understand the fundamental actions to take in the event of partial loss of intact buoyancy
- Demonstrate knowledge of the fundamental actions to be taken in the event of partial loss of intact buoyancy
- Use tables and diagrams of ship stability and trim data to calculate the ship's initial stability, drafts, and trim for any given disposition of cargo and other weights
- Demonstrate knowledge of principal structural members of a ship and the proper names for various parts

SYLLABUS

NM 3202STRENGTH OF SHIPS

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

Examination Theory: 3hrs. Credits: 4

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.

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 ended beam. Ultimate longitudinal strength of a ship.

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.

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.

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.

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.

NM 3203 SHIP DESIGN – II

Course objectives: Introducing basic ship theory, the ship design process, and systems engineering concepts. Hands on development of a computer code for ship hydrostatics analysis. Hands on experiments on ship stability and resistance. Visits and exercises on board ships. Individual ship design project and related workshops.

Course outcome:

This course gives an introduction to naval architecture, i.e. the engineering design of ships and other marine technology systems, and basic ship theory such as hydrostatics, stability, resistance and propulsion. The objective is that students after finishing the course shall be able to:

- Demonstrate knowledge and understanding of the scientific basis and proven experience of ship design and insight into current research and development work;
- Demonstrate methodological knowledge and understanding in ship hydrostatics, stability, resistance and propulsion;
- Demonstrate ability to model, simulate, predict and evaluate ships' hydrostatics, stability, resistance, and energy and resource efficiency, even on the basis of limited information;
- Demonstrate ability to critically, independently and creatively make the initial design of a ship for a certain transport scenario, taking into account relevant scientific, social, ethical, economic and environmental aspects, and international regulatory frameworks;
- Give an account of the international shipping markets and the corresponding stakeholders, goods flow paths, and ship types;
- Discuss the opportunities for seaborne transportation in a sustainable society and describe the shipping-related environmental problems and measures for tackling them;
- Demonstrate ability to plan and carry out advanced engineering tasks within given frames using appropriate methods and to evaluate this work;
- Demonstrate ability to clearly present and discuss engineering conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts

SYLLABUS

NM 3203 SHIP DESIGN – II

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

Examination Theory: 3hrs. Credits: 4

General Arrangements of Ships: General arrangement of ships. Layout of main and other decks. Water tight subdivision of the ship's 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**.**

Hull Fittings, Navigational aids and lifesaving 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. Lifesavingequipment primary and secondary types and ship requirements. Navigational equipment. Bulwarks railings and awnings, gangway, gangplanks, and gangway adders. Masts and rigging, mast designs.

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.

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

NM 3204(A) MARINE MANUFACTURING TECHNOLOGY

Course outcome: Introduce students to theory and operation of manufacturing including manufacturing processes and equipment overview, manufacturing design, production process and flow, materials, machine operations and logistics.

Course objective:

- Identify the different stages of a manufacturing process.
- Interpret the elements of the product design process.
- Identify the common machines used in a manufacturing process.
- Explain the operations and capabilities of machines used in manufacturing.
- Determine the operations used in finishing manufactured products.
- Explain the operations and capabilities of automated machines used in manufacturing.
- Interpret the functionality of base lining and documentation in a manufacturing process.
- Determine the main elements of quality assurance in a process.
- Identify characteristics of end product logistics.

SYLLABUS

NM 3204(A) MARINE MANUFACTURING TECHNOLOGY

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

Foundry: Foundry tools and appliances, layout – pattern types, materials, allowances, pattern making, moulding sands, types. Moulding methods, equipment for moulding, casting methods.

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.

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.

Drilling and Boring Machines (Elementary Treatment only): Classification, specifications, cutting speed, feed, machining times, parts and description of boring machines, types.

Power Press: Operation, components, classification, selection, cutting dies, power requirements, power press operations, punching, blanking, deep drawing.
Linear and angular measurements: Micrometers, Slip gauges, Vernier and optical bevel Protractors, sine bar Angle gauges.
Comparators: Types, Mechanical, Electrical, Electronic comparators. Measurement of Straightness- flatness- square ness and symmetry- parallelism and circularity.
Metrology: Metrology of screw threads and Metrology of gears (Measurement of Pitch and tooth thickness only).
Grinding: Introduction-abrasives-grinding wheels, bonding processes, selection of grinding wheels-grinding machines-classification-honing-lapping, super-finishing, buffing, polishing, selection of process parameters.

Text Books:

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

SYLLABUS

NM 3204(B) FISHING VESSELS TECHNOLOGY

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

Examination Theory: 3hrs. Credits: 4

Importance of fishing, Classification of fish for harvesting. Fishing methods- Purse seining, Drift netting, Gillnet fishing, Long line fishing. Pole and line fishing, Trawling, Harpooning.

Fishing Gear- Towed gear, Bottom trawling, side trawling, Towing arrangements, stern trawling operations and equipment, multiring trawling, Midwater trawling, Purse seining Types, Analysis of fishing nets.

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

Design of fishing vessels. Side trawlers, stern trawlers, purse seining. General arrangement, Layout and equipment on deck. Determination of main dimensions. Estimation of component weights. Development of lines. Estimation of resistance. Design of propellers for trawlers. Machinery- main and auxiliary, Electrical systems, structural arrangements. Materials for the construction of fishing vessels.

Economics of fishing vessels. Estimation of initial and operation costs. The influences of size, speed, power, selling price, distance optimised fishing vessel design. Design and economics of simple low cost country fishing crafts.

References Books:

1. Design of Small Fishing Vessels by John Fyson

2. Fishing Boats of the World by Jan-Olof Traung

NM 3205(OE) NAPA /RHINO /EXACT FLAT LAB

NM 3206 MARINE HYDRODYNAMICS LAB

Periods/week :3 Ses. : 50 Exam : 50

Examination Practical: 3hrs. Credits: 1.5

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.

NM 3207 MARINE INSTRUMENTATION AND METROLOGY LAB

Periods/week: 3 Ses. : 50Exam: 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.

NM 3208 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 ship's hull. Calculation of LCG and VCG of ship and off centre line 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

NM 3209 SKILL ADVANCED COURSE

B. Tech -IV Year- I Semester

Course code	Category	Course Title	Hours per week		Int Marks	Ext Marks	Total Marks	Credits
			L	P				
NM 4101	PE	Marine Hydrodynamics Advanced Welding Tech	4	0	30	70	100	3
NM 4102	PE	sea keeping and manoeuvrability Dyn of Offshore Structures	4	0	30	70	100	3
NM 4103	PE	Diesel of Small Crafts Naval Vessels	4	0	30	70	100	3
NM 4104	OE	Marine Instrumentation and Control Ship Vibrations	4	0	30	70	100	3
NM 4105	OE	CASD Underwater Acoustics	4	0	30	70	100	3
NM 4106	HSS	Industrial Engineering and management	4	0	30	70	100	3
NM 4107	SC	Skill advanced course	1	2	50	50	100	2
Summer Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester								2
Total credits								**22**

NM 4101 (A) MARINE HYDRODYNAMICS

Course Objectives: To provide students with a sufficient introduction to each of the topics of the course so that he/she will be able to understand the background of current literature in the hydrodynamics of marine vehicles, offshore engineering, and other ocean-related activities.

Course Outcomes: Students with ocean- and marine-related interest will develop the necessary theoretical and experimental background to keep up with existing literature and begin research on contemporary topics.

SYLLABUS

NM 4101 (A) MARINE HYDRODYNAMICS

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

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.

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.

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.

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.

Text Book:

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

NM 4101 (B) ADVANCED WELDING TECHNOLOGY

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

Examination Theory: 3hrs. Credits: 4

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.
Plastic Welding: Forge Welding: Types, Forged joints etc. Resistance Welding: Principle, types, spot, seam, etc. Thermit welding.

Gas Welding: Principle, equipment, different gas flames, gas welding techniques, types of gas welding, oxy-acetylene, air-acetylene, and oxy-hydrogen welding etc.

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.

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.

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).

Text Books:

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
6. Welder Trade Theory by S.K. Singh

NM 4102(A) SEA KEEPING AND MANEUVERABILITY

Course outcomes:

- Apply the concepts of Static Equilibrium and Archimedes' Principle to the operation of a ship.
- Demonstrate the ability to assess the stability condition of a ship. Predict the effect of planned shipboard evolutions on ship stability.
- Understand the significance of damage to a ship which has compromised its watertight integrity. Use hydrostatics to make intelligent and safe choices to maintain a ship afloat and upright.
- Understand the structural arrangement of a ship, including the choice of materials and the stresses developed by loads encountered in its operating environment.
- Understand the different components that make up a ship's resistance and the manner in which the propulsion plant transmits its power to overcome those forces.
- Understand factors affecting the seakeeping and maneuverability of ships in a seaway.

Course objective:

This course is an introduction to the applied science of ship systems. The course describes ships and submarines and how they remain afloat from a design and application perspective. Included are topics in hydrostatics, ship stability and operability, materials, fluid dynamics and propulsion.

SYLLABUS

NM 4102(A)- SEA KEEPING AND MANOEUVRABILITY

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

Examination Theory : 3hrs. Credits: 4

Introduction to sea keeping: Importance of sea keepinganalysis. 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.

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.

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.

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

Stabilization of ship motions: Roll stabilizers- Bilge keels, Gyroscopic stabilizers, Movement of weight, Rudder action, Jet flaps, Stabilizing fins, Passive and Active tank stabilisers.

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.

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.

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

NM 4102(B)– Dynamics of Offshore Structure

Periods/week : 4 Ses. : 30 Exam : 70
Examination theory: 3hrs. Credits: 3 Module 1 h 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 modelling 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.

Structures in the offshore environment - Description of typical offshore structures – Fixed-Compliant Floating - Solid fluid interaction parameters - Spring factor - Added mass and damping Response of offshore structures - Modelling of offshore structures – single and multi-degree freedom systems – effect of foundations

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

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.

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.

NM 4103(A) DESIGN OF SMALL CRAFTS:

Course objectives:provides a broad overview of craft design, construction and operation. The craft design process may be broken down broadly into two stages: Conceptual and/or preliminary design. The preliminary design process will normally take the form of a techno-economic appraisal, using a fundamental engineering economy approach.

Course outcome:

- demonstrate ability to critically, independently and creatively make the initial design of a ship for a certain transport scenario, taking into account relevant scientific, social, ethical, economic and environmental aspects, and international regulatory frameworks;
- give an account of the international shipping markets and the corresponding stakeholders, goods flow paths, and ship types;
- discuss the opportunities for seaborne transportation in a sustainable society and describe the shipping-related environmental problems and measures for tackling them;
- demonstrate ability to plan and carry out advanced engineering tasks within given frames using appropriate methods and to evaluate this work

SYLLABUS

NM 4103(A) DESIGN OF SMALL CRAFTS

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

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.

Dredgers: Types of dredgers, Hydrostatics and stability considerations. Powering and dredging machinery and equipment. Disposal of dredged material. Design considerations.

High speed crafts: Their role in offshore and naval operations. Special features. Design considerations

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

SYLLABUS

NM 4103(B) NAVAL VESSELS

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

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.

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.

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.

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.

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.

NM 4104(A) MARINE INSTRUMENTATION AND CONTROL

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

Instrumentation: Concepts of measurements, static performance, characteristics accuracy of measurement and its analysis. Instrumentation, for measurement: Force, torque, strain. pressure, flow, temperature and vibration.

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.

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.

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.

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.

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.

NM4104(B)SHIP STRUCTURAL DESIGN AND VIBRATION:

Course objective:

Presentation of the basic notions of the vibration theory and ship vibration. Definition of vibration problems and consideration of possibilities for their solutions. Reliable prediction of vibration level in the ship design stage. Review of vibration measurement procedures and vibration remedy

Course outcomes:

Upon completion of the course, students will be able to:

- understand basic principles of ship vibration.
- prepare input data for global hull-girder ship vibration analysis.
- apply analytical and numerical sollutions of free and forced global hull-girder vibration.
- apply FEM to ship vibration problems.
- understand problem of the fatigue of ship structural details and calculation procedures for estimation of the fatigue life

SYLLABUS

NM4104 (B)SHIP STRUCTURAL DESIGN AND VIBRATION

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

Examination Theory: 3hrs. Credits: 4

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.

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.

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.

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.

Hull Vibration Of Ships: Flexural Vibrations Of A Beam. Free And Forced Vibrations, Vibration Of Undammed Spring-Mass System, Damped Vibrations. The Exciting Forces On Hull Of Ships, Modes Of Hull Vibration. Calculation Of Hull Frequencies – Factors Influencing Frequency, Empirical Formulae For Hull Frequency Estimation. Analytical Methods For Calculation Of Hull Modes (Elementary Treatment Only). The Stodala's Interpolation Method.

Propeller Exciting Forces. Damping – Types Of Damping. Special Local Vibration Problems – Rudder Vibration, Cavitation, Stress And Vibration Levels, Human Reaction To Vibration.

General Methods Of Reducing Vibrations. Devices For Reducing Main Hull Vibration. Synchronising Devices For Twin – Screw Ships, Rotating Weight Neutralisers, Kurt Nozzles.

Reference Books:

1. Strength Of Ship Structures By W. Muckle
2. Ship Construction By D.J. Eyers
3. Principles Of Naval Architecture By Ed.V. Lewis
4. Ship Design And Construction By R.Taggart

NM 4105(A) CASD

COMPUTER AIDED SHIP DESIGN

Course Objective: To acquaint and equip with the computer aided design and manufacturing of farm machinery with the help of CAD.

Course outcomes: Successful achievement of master level outcomes is required to receive a passing grade in the course. .

- Ability to create fully constrained solid models that can be quickly modified using standard software tools.
- Ability to use, identify and explain standard features in solid modeling including protrusions, revolutions, cutouts, and patterns
- Ability to use standard software tools to create engineering drawings, or other documents, to fully describe the geometries and dimensions of parts, as well as to document assemblies according to standard practice
- Ability to use standard software tools to create part assemblies and check for clearances.
- Ability to create the drawings of farm implements and their analysis.
- Ability to write the CNC part programming

SYLLABUS

NM 4105(A) COMPUTER AIDED SHIP DESIGN

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

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.

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.

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.

Database systems, structures, entity-relation models, Application to ship design, model manufacturing and testing, CAD applications in ship building, Computer aided manufacture, Numerical control, Part programming.

Text Books:

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

References:

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

NM 4105(B) UNDERWATER ACOUSTICS

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,

Active sonar

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, Fulland 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

NM4106 (HSS)INDUSTRIAL ENGINEERING AND MANAGEMENT

NM 4107 (SC) SKILL ADVANCED COURSE

B. Tech -IV Year- II Semester

Course code	Category	Course Title	Hours per week	Internal Marks	External Marks	Total Marks	Credits

			L		P				
NM 4201	Major Project	Project work, seminar and internship in industry	0		0	-	100	100	14
Internship (6 Months)									
Total credits									**14**