

B.TECH. (HONS) IN OCEAN ENGINEERING & NAVAL ARCHITECTURE

Sl.	Sem	Subject No.	Name of the Subject	L-T-P	C
1	1	NA10001	Mathematics-I	3-1-0	4
2	1	NA10003	Chemistry	3-1-0	4
3	1	NA10701	Chemistry Laboratory	0-0-3	2
4	1	NA10005	Mechanics	3-1-0	4
5	1	NA10007	Electrical Technology	3-0-0	3
6	1	NA10703	Electrical Technology Laboratory	0-0-3	2
7	1	NA10009	English for Communication	3-0-0	3
8	1	NA10705	Engineering Drawings and Graphics	0-0-3	2
9	1	NA10707	Workshop Practice	0-0-3	2
10	1	NA10501	EAA	0-0-3	1
Total				15 3 15	27

Sl.	Sem	Subject No.	Name of the Subject	L-T-P	C
9	2	NA10002	Mathematics-II	3-1-0	4
10	2	NA10004	Physics	3-1-0	4
11	2	NA10702	Physics Laboratory	0-0-3	2
12	2	NA10006	Programming & Data Structure	3-0-0	3
13	2	NA10704	Programming & Data Structure Laboratory	0-0-3	2
14	2	NA10706	Engineering Drawings & Graphics	0-0-3	2
15	2	NA10708	Workshop Practice	0-0-3	2
16	2	NA10008	Fluid Dynamics	3-1-0	4
17	2	NA10010	Introduction to Naval Architecture	3-0-0	3
18	2	NA10502	EAA	0-0-3	1
Total				15 3 15	27

Sl.	Sem	Subject No.	Name of the Subject	L-T-P	C
17	3	NA20001	Mathematics-III	3-0-0	3
18	3	NA20003	Thermodynamics	3-1-0	4
19	3	NA20005	Basic Electronics	3-1-0	4
20	3	NA20701	Basic Electronics Laboratory	0-0-3	2
21	3	NA20007	Hydrostatics & Stability	3-1-0	4
22	3	NA20009	Marine Hydrodynamics	3-1-0	4
23	3	NA20501	EAA	0-0-3	1
Total				15 4 6	22
Sl.	Sem	Subject No.	Name of the Subject	L-T-P	C
24	4	NA20002	Machine Design	3-1-0	4
25	4	NA20004	Elements of Ocean Engineering	3-0-0	3
26	4	NA20006	Resistance & Propulsion	3-1-0	4
27	4	NA20008	Marine Construction & Welding	3-0-0	3
28	4	NA20010	Marine Structures-I	3-0-0	3
29	4	NA20702	Marine Structures computations	0-0-3	2
30	4	NA20704	Hydrostatics & Stability calculations	0-0-3	2
31	4	NA20502	EAA	0-0-3	1
Total				15 2 9	22

Sl.	Sem	Subject No.	Name of the Subject	L-T-P	C
31	5	NA30001	Marine Structures II	3-0-0	3
32	5	NA30003	Motion & Control	3-1-0	4
33	5	NA30005	Marine Design-I	3-0-0	3
34	5	NA30007	Marine Production	3-1-0	4
35	5	NA30009	Marine Materials	3-0-0	3
36	5	NA30701	Hydrodynamics Laboratory	0-0-3	2
			Total	15 2 3	19
Sl.	Sem	Subject No.	Name of the Subject	L-T-P	C
37	6	NA30002	Marine Design II	3-0-0	3
38	6	NA30004	Marine Systems	3-0-0	3
39	6	NA30006	Computer Aided Design & Production	3-0-0	3
40	6	NA30008	Industrial Management	3-0-0	3
41	6		Elective I	3-0-0	3
42	6	NA30702	Marine System Laboratory	0-0-3	2
43	6	NA30704	CAD-& Production Laboratory	0-0-3	2
			Total	15 0 6	19

Sl.	Sem	Subject No.	Name of the Subject	L-T-P	C
44	7	NA40901	Industrial Training	0-0-0	2
45	7	NA40801	Ship Design Project	0-0-12	6
46	7	NA40001	Business Fundamentals & Economics	3-0-0	3
47	7	NA40003	Vibration & Noise	3-1-0	4
48	7	NA40701	Vibration & Noise Laboratory	0 -0-3	2
49	7	NA40005	Marine Power Plant	3-0-0	3
50	7	NA40903	Comprehensive Viva-voce	0-0-0	2
			Total	9 1 15	22
Sl.	Sem	Subject No.	Name of the Subject	L-T-P	C
51	8	NA40802	Project	0-0-12	6
52	8	NA40902	Viva-voce	0-0-0	2
53	8	NA40002	Physical Oceanography	3-0-0	3
54	8	NA40904	Seminar	0-0-0	2
55	8		Elective II	3-0-0	3
56	8		Elective III	3-0-0	3
57	8	NA40004	Automation & Control Theory	3-0-0	3
			Total	12 0 12	22

TOTAL CREDITS: 180

Electives I, II, & III

Subject No.	Subject	L	T	P	C
NA30010	High Performance Marine Vehicle	3	0	0	3
NA30012	Port Infrastructure and Management	3	0	0	3
NA30014	Fishing Vessel Technology	3	0	0	3
NA30016	Inland Water Transportation	3	0	0	3
NA30018	Submarines and Submersibles	3	0	0	3
NA30020	Environmental Management	3	0	0	3

Note: L = Lectures

T = Tutorials

P = Practicals

C = Credits

Subject Numbering System (NAXYYZZ)

NA : Naval Architecture department –NA&OE course

X : Year level of the course (1,2,3,or 4)

YY : 00 --- Theory subject
05 --- Industrial Training
07 --- Laboratory
08 --- Project
09 --- Seminar, Viva-voce

ZZ : Sequential odd number of subjects in odd semesters (01,03,05)

Sequential even number of subjects in even semesters (02,04,06...)

Mathematics-1

NA10001

3 -1 -0 : 4 Credits

Rolle's Theorem, Cauchy's mean value theorem (Taylor's and Maclaurin theorems with remainders), indeterminate forms; Concavity and convexity of a curve, points of inflexion, asymptotes and curvature.

Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutativity, Euler's theorem on homogeneous functions, harmonic functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables, Lagrange's method of multipliers.

First order differential equations, exact linear and Bernoulli's form, second order differential equations with constant coefficients, Euler's equations, system of differential equations.

Limit, continuity, differentiability and analyticity of functions; Cauchy-Riemann equations, elementary complex functions, line integrals, Cauchy's integral theorem, Cauchy's integral formula, power series, Taylor's series, Laurent's series, zeros and singularities, residue theorem.

Fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals's reduction formulae.

Chemistry

NA 10003

3 - 1 -0 : 4 Credits

Thermodynamics of Chemical Processes : Concept of entropy, chemical potential, equilibrium conditions for closed systems, phase and reaction equilibria, Maxwell relations, real gas and real solution.

Electrochemical Systems : Electrochemical cells and EMF, applications of EMF measurements: thermodynamic data, activity coefficients, solubility product and pH, corrosion.

Kinetics of Chemical Reactions : Reversible, consecutive and parallel reactions, steady state approximation, chain reactions, photochemical kinetics.

Bonding Models in Inorganic Chemistry : Molecular orbital theory, valence-bond theory, crystal field theory.

Fundamentals of Microwave, IR and UV-VIS Spectroscopy : Basic concepts of spectroscopy, selection rule, determination of molecular structure.

Coordination Chemistry : Coordination numbers, Chelate effect, coordination complexes and application, bio-inorganic chemistry : Metal ions in biological systems; environmental aspects of metals, NO_x, CO, CO₂.

Organic Reaction Mechanism : Mechanisms of selected organic, bio-organic, polymerization and catalytic reactions.

Stereochemistry of Carbon Compounds : Selected Organic Compounds : natural products and bio-molecules (amino acids/nucleic acids/proteins).

Chemistry Laboratory

NA 10701

0 - 0 -3 : 2 Credits

Suggested Experiments :

- 1.Surface tension and parachor
- 2.Measurement of the coefficient of viscosity : CMC of a surfactant
- 3.Conductometric titration
- 4.pH-metric/potentiometric titration
- 5.Solubility product
- 6.Kinetics of ester hydrolysis
- 7.Estimation of Fe²⁺
- 8.EDTA titration
- 9.Estimation of base content and acid content of commercially available antacid and vitamin C respectively
- 10.Synthesis of Mohr's salt
- 11.Synthesis of aspirin
- 12.Demonstration of a few important physico-chemical processes. (e.g. Gel electrophoresis, Oscillatory reactions)

Mechanics

NA10005

3 - 1 -0 : 4 Credits

Force systems : Moment of a force about a point and about an axis; couple moment; reduction of a force system to a force and a couple.

Equilibrium : Free body diagram; equations of equilibrium; problems in two and three dimensions; plane frames and trusses.

Friction : Laws of Coulomb friction; problems involving large and small contact surfaces; square threaded screws; belt friction; rolling resistance.

Kinematics and Kinetics of particles : Particle dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables; central force motion.

Properties of areas : Moments of inertia and product of inertia of areas, polar moment of inertia, principal axes and principal moments of inertia.

Concept of stress and strain : Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, Hooke's law, Poisson's ratio, generalized Hooke's law; analysis of axially loaded members.

Torsion : Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation.

Flexural loading : Shear and moment in beams; load, shear and moment relationship; shear and moment diagrams; flexure formula; shear stress in beams; differential equation of the elastic curve, deflection of beams.

Transformation of stress and strain : Transformation of stress and strain; principal stresses; principal strains; Mohr's circle for stress and strain.

Combined loading : Axial and torsional; axial and bending; axial, torsional and bending.

Column : Buckling of slender columns, Euler bucking load for different end conditions.

Electrical Technology

NA10007

3 - 0 - 0 : 3 Credits

Introduction :

Sources of energy; General structure of electrical power systems, Power transmission and distribution via overhead lines and underground cables, Steam, Hydel, Gas and Nuclear power generation.

DC Networks : Kirchoff's laws, node voltage and mesh current methods, Delta-star and star-delta conversion, Superposition principle, Thevenin's and Norton's theorems.

Single phase AC Circuits : Single phase EMF generation, average and effective values of sinusoids, solution of R,L,C series circuits, the J operator, complex representation of impedances, phasor diagram, power factor, power in complex notation, solution of parallel and series parallel circuits.

Three phase AC Circuits : Three phase EMF generation, delta and Y connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits, three phase four wire circuits.

Magnetic Circuits : Ampere's circuital law, B ' H curve, solution of magnetic circuits, hysteresis and eddy current losses, relays, an application of magnetic force, basic principles of stepper motor.

Transformers : Construction, EMF equation, ratings, phasor diagram on no-load and full- load, equivalent circuit, regulation and efficiency calculations, open and short circuit tests, auto-transformers.

Induction Motor : The revolving magnetic field, principle of orientation, ratings, equivalent circuit, torque-speed characteristics, starters for cage and wound rotor type induction motors.

DC Machines : Construction, EMF and torque equations, characteristics of DC generators and motors, speed control of DC motors and DC motor starters.

Electrical Measuring Instruments : DC PMMC instruments, shunt and multipliers, multimeters, Moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watt-hour meter, extension of instrument ranges.

Electrical Technology Laboratory

NA10703

0 - 0 -3 : 2 Credits

Suggested Experiments

1. To measure the armature and field resistance of a DC machine.
2. To calibrate a test (moving iron) ammeter and a (dynamometer) Wattmeter with respect standard (DC PMMC) ammeter and voltmeters.
3. Verification of circuit theorems, Thevenin's and superposition theorems (with DC sources only).
4. Measurement of current, voltage and power in R-L-C series circuit excited by single phase AC supply.
5. Open circuit and short circuit tests on a single phase transformer.
6. Connection and starting of a three phase induction motor using direct on line (DOL) or star delta starter.
7. Connection and measurement of power consumption of a fluorescent lamp and voltage current characteristics of incandescent lamps.
8. Determination of open circuit characteristics (OCC) of a DC generator.
9. Two wattmeter method of measuring power in three phase circuit (resistive load only).

English for Communication

NA10009

3 - 0 -0 : 3 Credits

Evolution of values and the quality of life; The operative forces in society; The weaker nations and the weaker sections; The Indian psyche; Ethics of Science, Business and Politics; The Great Issues in the 21st Century; Science and Technology for Man and the Earth.

Interactive communication; Goals and means; Techniques of Business communication; Group discussion and formal presentation ; Effective speaking, pronunciation, intonation, choice of words, Effective writing - language, style, formal devices and modes

Engineering Drawings & Graphics

NA10705

NA10706

0 - 0 -3 : 2 Credits

Introduction to IS code of drawing; Conics and engineering curves - ellipse, parabola, hyperbola, cycloid, trochoid, involute; Projection of lines traces, true length; Projection of planes and solids; solid objects - cube, prism, pyramid, cylinder, cone and sphere; Projection on auxiliary planes; Isometric projection, isometric scale; Section of solids - true shape of section; Introduction to CAD tools basics; Introduction of development and Intersection of surfaces.

Workshop Practice

NA10707

NA10708

0 - 0 -3 : 2 Credits

Basic concepts and principles of manufacturing : *Performing processes* : Casting, forging, rolling, drawing, extrusion, press tool work, plastic moulding and powder metallurgy.

Joining processes : Welding, brazing and crimping semi-finishing and finishing processes ;
Machining (Turning, shaping, drilling, Milling and grinding).

Non-traditional processes : Abrasive jet machining, Ultrasonic machining, Electro-discharge machining, Electrochemical machining and laser beam machining.

Product Quality : Possible defects and their detection, assessment and remedy.

Suggested Assignments

Machining :

1. Introducing to various machine tools and demonstration on machining
2. Making a steel pin as per drawing by machining in centre lathe
3. External screw thread by single point chasing in lathe
4. Making a cast iron Vee block by shaping
5. Making a regular polygon prism (MS) by milling
6. Making a gauge as per drawing
7. Study of machining in machining centre (CNC) and Electro-discharge machining

(EDM)

Foundry Practice :

8. Orientation, demonstration and practice on metal casting
9. Practicing sand moulding using split and uneven parting line pattern
10. Practice on CO₂ moulding and machine moulding
11. Mechanised sand preparation and melting practice

Welding Practice :

12. Practice on Oxy-acetylene gas welding and manual metal arc welding (running bead)
13. Practice on oxy-acetylene gas cutting and arc welding for butt welding
14. Introduction and demonstration on submerged arc welding and plasma spray coating

Metal Forming :

15. Demonstration of deep drawing process

EAA (Extra Academic Activity)

0 - 0 -3 : 1 Credit

**NA10501
NA10502
NA20501
NA20502**

Extra Academic activity will be NSS only

Mathematics – II

NA 10002

3 – 1 -0 : 4 Credits

Vector spaces', linear dependence of vectors, basis, linear transformations, rank and inverse of a matrix, solution of algebraic equations , consistency conditions. Eigen values and Eigen vectors, Hermitian and skew Hermitian matrices.

Convergence of improper integrals, tests of convergence, Beta and Gamma functions, elementary properties, differentiation under integral sign, differentiation of integrals with variable limits Leibnitz rule, integrals dependent on a parameter application.

Rectification, double and triple integrals, computations of surfaces and volumes, change of, variables in double integrals , Jacobians of transformations, integrals dependent on parameters' applications. scalar and vector fields, level surfaces, directional derivative, gradient, curl, divergence, laplacian line and surface integrals, theorems of Green. Gauss and Stokes, orthogonal curvilinear coordinates.

Finite differences, Newton's forward and backward interpolation formulae, central difference interpolation. trapezoidal rule and Simpson's 1/3rd rule of integration. solution of polynomial and transcendental equations bisection method, Newton Raphson method and Regula Falsi method.

Physics

NA10004

3 –1 -0 : 4 Credits

Overview of vibrations with emphasis on damped and forced oscillations, resonance, coupled oscillations, normal modes.

Wave motion : longitudinal and transverse waves, wave equation, plane waves, phase velocity, superposition wave packets and group velocity, two and three dimensional waves, polarization.

Electromagnetic waves : Maxwell's equations, wave equation, plane electromagnetic waves, energy-momentum, Poynting's theorem, electromagnetic boundary conditions, reflection and refraction, interference, Young's experiment, interferometers, diffraction, Fraunhofer diffraction (single slit), dispersion, radiation.

Wave mechanics : failure of classical physics, qualitative review of relevant experiments, --De Broglie waves, uncertainty principle, wave function and Schrodinger equation, probability interpretation, particle on a chain, potential barrier and quantum tunneling, potential well, qualitative summary of simple harmonic oscillator and Hydrogen atom, occupation probability and examples.

Physics Laboratory

NA10702

0- 0-3: 2Credits

Suggested Experiments

- 1.Oscillation in potential well
- 2.Normal modes of coupled oscillators
- 3.Measurement of velocity of acoustic waves

4. Newton's rings
5. Specific rotation of an optically active source
6. Diffraction with laser
7. Dispersive power of a prism
8. Fresnel biprism
9. Franck Hertz experiment
10. Photoelectric effect
11. Measurement of band gap in semiconductors
12. Measurement of Hall effect

Programming & Data Structures

NA10006

3 - 0 -0: 3Credits

Introduction to the Digital Computer ; Introduction to programming ,variables, assignment; Expressions; Input/Output; Conditionals and branching; Iteration; Functions; Recursion; Arrays; Introduction to pointers; Structures; Introduction to Data-Procedure Encapsulation; Dynamic allocation; Linked structures; Introduction to Data Structure ; Stacks and Queues; Search Trees; Time and space requirements. (A programming language like C/C++ may be used as a basis language. The same language must be used for the laboratory).

Programming & Data Structures Laboratory

NA 10704

0- 0 -3 : 2credits

Suggested assignments to be conducted on a 3-hour slot. It will be conducted in tandem with the theory course so the topics for problems given in the lab are already initiated in the theory class. The topics taught in the theory course should be appropriately sequenced for synchronization with the laboratory. A sample sequence of topics and lab classes for the topic are given below :

1. Familiarization of a computer and the environment and execution of sample programs
2. Expression evaluation
3. Conditionals and branching
4. Iteration
5. Functions
6. Recursion
7. Arrays
8. Structures
9. Linked lists
10. Data structures

It is suggested that some problems related to continuous domain problems in engineering and their numerical solutions are given as laboratory assignments. It may be noted that some of basic numerical methods are taught in the Mathematics course

Fluid Dynamics

NA10008

3 - 1 - 0 : 4 Credits

Fluids – Physical properties, - density, specific gravity, specific volume, temperature, viscosity, compressibility, surface tension, vapor pressure, fluid static pressure, atmospheric pressure, pressure variation in incompressible fluid, absolute pressure, gauge pressure, manometer; buoyancy and floatation – Archimedes principle.

Fluid kinematics – viscous and nonviscous flow, compressible and incompressible flow, rotational and irrotational flow; potential flow - equation of continuity, Bernoulli's pressure equation, Analysis of flow in finite control volumes and application to siphon, venturi meter, orifice meter etc.,

Euler turbine equation: impulse and reaction turbines, similarity analysis, specific speed and classification of fluid machinery; design methodology of low speed axial and radial flow machines (i.e pumps, fans, and hydraulic turbines); losses in fluid machinery.

Introduction to Naval Architecture

NA 10010

3 - 0 - 0 : 3 Credits

Historical Development of naval architecture and ocean engineering; Marine environment i.e ships and offshore structures of various types; Ship parts and nomenclature; Design process and production process, Technology, Economics and business modern trends ; Role of a naval architect.

Mathematics III (Module 2)

NA20001

3 – 0 - 0 : 3 Credits

Probability : Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes Theorem and independence.

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's Inequality.

Special Distributions: Discrete uniform, binomial, geometric, Poisson, exponential, gamma, normal distributions, function of a random variable.

Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation, independence of random variables, bi-variate normal distribution.

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and f distributions. Estimation: The method of moments and the method of maximum likelihood estimation, confidence intervals for the mean(s) and variance (s) of normal populations.

Testing of Hypotheses: Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman - Pearson Fundamental Lemma, tests for one sample problems for normal populations.

Thermodynamics

NA20003

3 – 1 – 0 : 4 Credits

Fundamentals of Thermodynamics—Carnot's Cycle, ideal efficiency; enthalpy and entropy; laws of thermodynamics; heat engines and heat pumps.

IC Engine principles, working principle of diesel engines;
Steam and Air boilers and turbines – cycle combustim, reheat, regeneration, condenser and compressor.

Basic Electronics

NA20005

3 – 1 - 0: 4Credits

Introduction to electronics and electronic systems, Semiconductor and devices like diodes, BJT, FET, MOSFET, rectifier and filters, transistor biasing. small signal transistor amplifiers, operational amplifiers, feedback and oscillators, digital circuit and combinational logic, sequential logic and flip-flops, ADC & DAC, Data acquisition systems, Memory systems, Case studies of electronic systems like microprocessors, radio & TV broadcasting, Mobile & cellular telephones, fiber optics & networking.

Basic Electronics Laboratory

NA20701

0- 0-3 : 2 credits

Suggested Experiments
Familiarization of electronic equipments and components
Studies on Logic gates
Using studies on RC and CR networks
Studies on Rectifiers and Zener diode regulation
Studies on Op. Amp Applications
Studies on Flip-Flops and Counters
Design or a CE Amplifier
Application of Timer 555 chip

Hydrostatics and Stability

NA 20007

3 – 1 - 0: 4Credits

Hull form definition of ships and ocean structures; Deadweight, capacity and tonnage measurement
Hydrostatic calculations; Initial stability, fi7ee surface effects, stability at large angles; Intact and damaged stability computations; Damaged stability and its calculation by lost buoyancy and added

weight methods; IMO stability criteria; Subdivision and floodable length calculations; Subdivision indices; Launching calculations; Stability of fully submerged body; Stability of multibody systems; Pressure integration technique of computing hydrostatic and stability.

Marine Hydrodynamics

NA 20009

3 – 1 - 0 : 4 Credits

Introduction - ideal and viscous incompressible fluid; Kinematics of fluid; Lagrangian and Eulerian methods of description, velocity, acceleration, streamlines, pathlines, vorticity; Equation of continuity; Equations of motion; Bernoulli's equation and its application including pitot tubes and venturi meter; Two dimensional motion - velocity potential, stream function, Sources, sinks, dipoles; Flow past a circular cylinder with and without circulation; Blasius Theorem; Viscous fluids; Navier Stokes equations, Laminar flow, Poiseuille flow, Couette flow, flow through a pipe; Boundary layer, Reynolds Number; Boundary layer along a flat plate; Blasius solution; Separation, Von Karman momentum integral method; Turbulence, Calculation of turbulent boundary layer; Problems on the motion of perfect fluids - steady translation of a cylinder in an infinite fluid medium, unsteady translation; Added mass of cylinders; Spheres and Lewis forms; Aerofoil theory, complex potential; method of conformal mapping- Joukowski profile; Flow past a Joukowski profile; Aerofoil of finite aspect ratio - The vortex system, fundamental laws of vortex motion; Training vortices. bound vortices, downwash velocity; Lift; Induced drag; Gravity waves; Airy's wave; Free surface condition; Velocity potential- Dispersion relation; Surface tension effects; Orbital motion; Group velocity and its dynamical significance; Wave energy; Standing waves; Loops and nodes, Wave forces and Morison's equation, Long waves and waves in a canal; Tides.

Machine Design

NA 20002

3 – 1 - 0 : 4 Credits

General considerations & procedure of Machine Design: General Principle of Machine Design; Common engineering materials & their mechanical properties, factor of safety; Fits & tolerances. Design principle of machine elements: Fasteners & fittings, shaft, couplings, clutches, brakes, bearing selection, fly wheel, belt drive, chain drive, gears, gear train and gear units, non-metallic machine elements. Design and drawing of a few machine systems: Fasteners, power screw, gear units, clutch/brake.

Elements of Ocean Engineering

NA20004

3 - 0- 0 : 3 Credits

Brief introduction to ocean environment and ocean floor characteristics, waves, tides, currents, seawater properties; statistical analysis – distributions, multiple regression, correlation, auto-covariance, cross-spectra, practical applications in ocean engineering; Introduction to offshore structures-gravity platforms, jacket platforms, tension leg platforms, marine risers, submersibles, offshore pipelines, Instrumentation for ocean applications: pressure sensors, current meters, CTD, depth sounder, buoy systems etc. Fundamentals of mooring system and mooring cables. Submarine pipelines: interaction of pipelines with seabed: free span, scouring and burial of seabed pipelines, forces on sea-bed pipelines,

current & wave-induced vibrations of pipelines, lifting-off of pipelines, introduction to dredging and reclamation, ocean energy and fundamental principles of energy extractions from sea wa

Resistance and Propulsion

NA20006

3 - 1 - 0: 4Credits

Components of ship resistance; Dynamic similarity; Froude hypothesis; Viscous resistance; Laminar and turbulent flows; Effect of roughness; Friction lines; Form resistance; Wave resistance; Kelvin wave pattern and waves generated by a ship; Wave interference; Air resistance; Appendage drag; Ship resistance in shallow water; Resistance data presentation; Estimation of effective power - methodical series and statistical methods- Hull form and resistance.

Screw propeller geometry; Propeller theories; Laws of similarity for propellers; Propellers in "open" water; Propeller coefficients and design charts; Hull propeller interaction - wake, thrust deduction and relative rotative efficiency; Propulsive efficiency and its components; Propeller cavitation- Propeller blade strength; Propulsion experiments- Propeller design; Speed trials and service performance analysis; Unconventional propulsion devices.

Marine Construction and Welding

NA20008

3 - 0 - 0 : 3 Credits

Introduction to various types of ships and offshore structures; Aspects of shipbuilding technology; Structural components - bottom construction, shell plating, decks, fore and aft peak construction, superstructure and deckhouses, bulkheads; Framing system; Structural continuity; Steel material preparation - shot blasting, acid pickling etc; Plate cutting methods; Plate and section forming - mechanical methods and line heating techniques; Fusion welding – types of power source and their characteristics, welding methods - MMAW, GMAW, SAW, Electroslag welding; Welding parameters and their effect on welded joints; Welding distortions-causes and prevention; Welding defects; Nondestructive testing.

Marine Structures-I

NA20010

3 - 0 - 0 : 3 Credits

Forces acting on ship structure; Idealization of ship structure as hull girder; Longitudinal bending of hull girder—weight and buoyancy curves; deflection, shear force and bending moment diagrams; Section Effect of shear force in bending; Stresses in inclined conditions; modulus-bending and shear stresses, longitudinal strength standards; Analysis of bulkheads and decks; Structural discontinuities and stress concentration; Analysis of beam and frame using stiffness method; Introduction to elasticity; Plane stress and plate bending problems.

Marine structures Computations

NA20702

0- 0 - 3: 2Credits

Calculation of longitudinal strength of a ship - weight, buoyancy and load curves; Scantling of different structural components as per the requirements of classification societies; Computation of section ,modulus and stresses.

Hydrostatics & Stability Calculations

NA 20704

0 - 0 - 3 : 2 Credits

Lines plan drawing and computation of hydrostatics and stability of a given ship.

Marine Structures – II

NA30001

3 - 0 – 0: 3Credits

Understanding of the probabilistic nature of the forces acting on a marine structure, the use of current technologies to determine the structural response, Statistical representation of the sea surface, determination of design values of structural loading; simulation techniques for evaluating structural resistance; Methods of reliability assessment of structures; First Order Second Moment and Advance Second Moment methods; The role of reliability methods in the design of structures as the basis for design codes; Reliability of structural systems; Case studies on the use of reliability methods—offshore structures

Motion and Control

NA30003

3 - 1 - 0 : 4 Credits

Introduction to sea-keeping. Recapitulation of surface gravity waves. Description of irregular waves: Wave spectrum. Ship motions in regular waves: Frequency of encounter, natural periods, RAO. Motions in regular waves; response spectra. Derived responses: Slamming, deck wetness, relative motions, sea-sickness etc. Design considerations for seakeeping. Introduction to maneuverability: various types of directional stability. Basic hydrodynamics and motion equations of a maneuvering body. Hydrodynamic and control derivatives. Stability criteria Various definitive maneuvers: turning, zigzag, spiral, etc. Heel during turn. Experimental determination of hydrodynamic derivatives. IMO maneuvering standards. Rudder: geometry, hydrodynamics and design.

Marine Design - I

NA 30005

3 - 0 - 0 : 3Credits

Engineering design - philosophy and definition; Marketing principles in marine environment; Classification of marine vehicles on the basis of mission analysis; Properties of cargo; Engineering economic criteria and complexities, operating cost, optimal vessel design; Design spiral, concept design, objectives and constraints, preliminary design; Hull form design and development; General arrangement design - space and volume layout, access arrangements.

Marine Production

NA30007

3 - 1 - 0: 4 Credits

Overview of ship production systems; Information for shipbuilding production; Product standardization and work simplification; Product work breakdown and integrated zone engineering; Linear programming concepts; Network analysis; Scheduling and resource allocation; DBMS in production planning and control.

Marine Materials

NA30009

3 – 0 - 0 : 3 Credits

Material types - fabrication and service requirement; Classification society requirement- Selection of material for marine construction; Types of shipbuilding quality steels - Mild steel, HTS, HSLA steel, etc; Heat treatment techniques - effect of thermal cycles on their micro-structure, Material composition of MS, HTS etc. and their effect on weldability and corrosion; Corrosion mechanism of steel - design aspects and prevention techniques. Aluminium alloys - alloy designation, welding requirements; Composites - types of resins, glass and carbon fibers, their properties; Lay up techniques, manufacturing requirements

Hydrodynamics Laboratory

NA30701

0 – 0 - 3 : 2 Credits

Study of hull and propeller models, calibration of resistance dynamometer, towing test, extrapolation of model resistance to full scale, calibration of propeller open water dynamometer, propeller open water test, propeller open water performance calculation.

Marine Design – II

NA 30002

3 - 0 - 0 : 3 Credits

Structural Layout and design: Design of various ship systems and marine power plant: accommodation arrangement, safety and pollution prevention; Paints and corrosion prevention specifications, building cost estimation, tender and contract.

Introduction to Warships – types, mission requirement, machinery and equipment, hull form-special requirement, mass and space distribution.

Marine Systems

NA30004

3 - 0 - 0 : 3 Credits

Shafting System; Heavy Fuel Oil(HFO), Marine Diesel Oil(MDO) and Lubricant Oil(LO) storage, transfer and purification systems; Fresh Water and Sea Water systems; Firefighting and Ballast Water systems; Sludge control and oily water purification systems; Electrical load calculation, power generation and distribution systems; Cargo handling – dry break-bulk, unitized and bulk cargo, liquids in bulk, cryogenic liquids etc.; Pumps, piping and valves; Life saving and fire fighting systems; Steering and navigation systems; Anchoring and mooring systems.

Computer Aided Design and Production

NA 30006

3 - 0 – 0 : 3 Credits

Introduction, Engineering CAD systems, Curve representation, Analytical and parametric representation of curves, Differential geometry of curves, Interpolation of Techniques, Control polygon techniques (Beziers, B-Spline , Nurbc) Curve generation, Ship Curve design, Intergration and fairing techniques for curves, Surface representation, Analytical and parametric representation of surfaces, Differential geometry of surfaces, Surface interpolation techniques, Control polygon techniques (Beziers, B-Spline, Nurbs), Surface generation, Interrgation and fairing techniques for curves, Ship surface designruled surface, developable surface, low curvature surface, Introduction to CNC programming and application, Principles of numerical control, Manual programming, Introduction about preparatory codes (G & M codes)

Industrial Management

NA30008

3 - 0 – 0 : 3 Credits

Principles of Management; Strategic Management; Quality control and TQM; Materials Management; Maintenance Management; Operations research; Human Factors in Engineering; Human Resource Management.

CAD -&Production Laboratory

NA30704

0 - 0 – 3 : 2 Credits

Concept and Preliminary Design, Hull form modeling, Development and surface modeling. CNC programming for milling, drilling, surface finishing, thread cutting.

Industrial Training**NA 40901****0 - 0 - 0 : 2 Credits**

Practical training in a marine industry for 8 weeks in the summer vacation after 6th semester.

Ship Design Project**NA40801****0-0-12 : 6 Credits**

Student has to do the preliminary design of an assigned merchant vessel and write brief specifications

Business Fundamentals & Economics**NA40001****3 – 0 - 0 : 3 Credits**

Contents:

Introduction; Demand and Supply Analysis; Production and Cost; Price - Output determination; Capital market and investment decisions; Outline of Welfare Economics; Resource accounting and sustainability; Income determination and fluctuations; Trade; Aid and Development; Economic systems & Indian economic policies.

Vibration and Noise**NA40003****3 – 1 - 0 : 4 Credits**

Introduction to mechanical vibration; Hull Girder vibration, calculation of natural frequencies of hull girder vibration, propeller induced vibration, shaft vibration, local vibration, vibration control and mount design. Introduction to noise –structure born noise and radiated noise, noise characteristics, marine standards on noise rating; noise measurement and analysis, noise insulation, absorption and isolation.

Vibration and Noise Laboratory**NA40701****0 - 0 - 3 : 2 Credits**

Free and forced vibration experiments of single degree freedom systems; On-board vibration and noise measurement and analysis.

Marine Power Plant**NA40005****3 - 0 - 0 : 3 Credits**

Steam Power plants – principles of heat transfer, component efficiency, effects of contamination and blow down; operating principles of diesel engines, Thermodynamics of steam turbines, gas turbines and diesel engines, Fuels- different fuel oils, coal, nuclear fuel, analysis of fuels; Air requirement, Analysis of Fuel gasses; Air compressors and turbo charging; combined engines as marine power plant- CODOG, CODAG, electric propulsion etc., Alternative/Renewable sources of power.

Comprehensive Viva-voce**NA40903****0 - 0 - 0 : 2 Credits**

Viva-voce examination will cover all subjects taught till date.

Project**NA40802****0 – 0 - 12 : 6 Credits**

The student is assigned a project leading to advancement in the topic chosen under a supervising teacher. He has to submit a project report.

Viva-voce**NA40902****0 – 0 - 0 : 2 Credits**

This is a viva-voce in the project work.

Physical Oceanography**NA40002****3 – 0 - 0 : 3 Credits**

Ocean Dimension, shapes and bottom materials - Continental shelf, slope and rise, deep sea bottom and sounding, sills, bottom materials; Physical properties of sea water - Salinity and conductivity, Temperature, Density effects, Sound and light in the sea, Color of sea water; Distribution of water characteristics - Density distribution, Pycnocline, Static stability, Geographical distribution of density, temperature distribution, Potential temperature, Dissolved oxygen; Heat budget of the Oceans - conservation of volume, salt and heat budget, Geographical distribution of heat budget; Ocean Dynamics - Hydrostatic balance, Small scale mixing/stability, Navier-Stokes Equation, Rotating coordinate systems, Turbulence, Surface gravity waves, Inertial currents, Circulation and water masses of the Oceans - Thermohaline circulation, Wind driven circulation, Circulation and water masses, Indian Ocean circulation and water masses, El nino, Monsoons, Tides; Coastal Processes - coastal upwelling, estuaries, types of estuaries, estuarine circulation; Problem session.

Seminar

NA40904

0 – 0 - 0 : 2 Credits

Seminar on a selected topic.

Automation & Control Theory

NA40004

3 – 0 - 0 : 3 Credits

Brief introduction about industrial processes and their automation; Elements of pneumatic, hydraulic and electrical control systems; Valves and actuators; Stepper motors; PID controllers and their tuning; Implementation of digital controller; Control strategies for industrial processes; Programmable logic controller; Real-time issues on signal transmission and control; Communication systems for industrial automation; Data acquisition and supervisory control; Control of discrete manufacturing processes; Intelligent systems for monitoring, supervision and control; Case studies of industrial control systems.

Electives

High Performance Marine Vehicle:

NA30010

3 – 0 - 0 : 3 Credits

Classification of high performance vehicles; Comparison of vehicles on the basis of power, seakeeping and economics; Special design features of high performance vehicles- Materials for high performance marine vehicles; Structural design considerations; Propulsion machinery and propulsion devices; High speed displacement craft: design procedures, estimation of power, systems design considerations; Planning craft: planning phenomena, estimation of power, hull form design, Hydrofoil craft: foil types and configurations, design of foils, stability when foilborne; Propulsion considerations; Air cushion vehicles types of air cushion and their effectiveness, cushion sealing arrangements, resistance in calm water and in waves, propulsion and maneuvering arrangements; surface effect ships; High speed catamarans; Wing-in-ground effect craft; Hybrid craft.

Port Infrastructure and Management:

NA30012

3 – 0 - 0 : 3 Credits

Introduction: Ports and harbors as the interface between the water and land infrastructure- an infrastructure layer between two transport media

The fundamentals: Wave conditions inside harbor-wave disturbances & seiching;
Water circulation

Breakwaters, jetties & quay walls; Mooring, berthing and ship motion inside the port
Cargo handling

Design issues: Port layout in regards to (1) wave action (2) siltation (3) navigability (AKO) Berthing Facilities
Design of port infrastructure in regards to (1) cargo handling (2) cargo storage (3)integrated transport of goods
Planning multipurpose port terminals

Port operations: Physical aspects: Allowable wave conditions for cargo handling, Wave conditions for human safety on quays and breakwaters, Forecasting/nowcasting of wave & current conditions for port operations, Dredging and navigability, Hazard scenarios

Management aspects: VTMS & Management of computerized container terminal, Safety & environment (handling of fire, oil spill, rescue,...) Total Quality Management in ports.

Sustainability: Global trades & port restructuring /reforms, Impacts of possible climate change scenarios, Sustainable development strategies for cities & Ports

Case Studies:

Layout, operations and future issues of one or tow existing ports to be analysed.

Fishing Vessel Technology:

NA30014

3 – 0 - 0 : 3 Credits

Types of sea fish for human consumption; Fishing methods and gear types; Fish finding and communication equipment; General arrangement and space requirement of fishing craft- Stability, propulsion systems and seakeeping characteristics of fishing craft; Fish hold architecture; Fish processing and preservation; Fishing harbor design; Fisheries economics.

Inland Water Transportation:

NA30016

3 – 0 - 0 : 3 Credits

Inland waterways and their peculiarities; Maintenance of Navigation Channels; Siltation bank erosion and dredging; inland river ports, jetties and facilities; intermodal transportation – with sea, road and rail; Specialised intermodal transportation vessels; low draught and low wash self propelled vessels- Special features – tunnels, shrouded propeller, Inland river vessel design - dumb barges, flotilla/pusher tugs.

Submarines and Submersibles:

NA30018

3 – 0 - 0 : 3 Credits

The submersible systems: Characteristics of submarines and submersibles; Operating environment; Materials used in submarines and submersibles- Structural and non-structural; Stability considerations- Hydrodynamics of submerged vehicles – resistance, propulsion and

manoeuvring; Structural considerations – Pressure hull and exo-structure; Support systems; Safety considerations; Basic design of manned and unmanned submersibles.

Environmental Management:

NA30020

3 – 0 - 0 : 3 Credits

Pollution of Ocean Environment – Discharges from ships and offshore platforms - air, oil sewage and garbage; Pollution of Coastal waters – discharges from industries, riverine discharge and dredging; Pollution of Port waters – ballast water, ship's discharge, cargo discharge (oil and ore); Environmental problems due to maritime construction on near shore areas, dismantling of maritime structures and ships; Occupational health and hazards.

IMO and regulatory mechanism to check pollution; Quality systems for environmental control; Environment maneuvering, alternative methods of technology, education and training.