SYLLABUS FOR B.TECH. DEGREE COURSE IN NAVAL ARCHITECTURE & SHIPBUILDING
(8 SEMESTER DURATION)

SEMESTER I

ST 01 H1 HUMANITIES

Module I
Communication: Introduction, importance of communication, communication in primitive societies. Objectives of communication - information, advice, order, suggestion, persuasion, education, warning, raising morale, motivation. Mass communication – written and oral communication, audio-visual communication, role of newspapers, radio, cinema, T.V.; Principles of communication – clarity, completeness, conciseness, consideration, courtesy, correctness, choice of right word; The art of listening- learning through listening, body language.

Module II
Types of communication: Official and business communication – downward communication, upward communication, and horizontal communication. Comprehension – comprehension of ideas in a passage, expansion of an idea for a particular purpose; Summarizing a passage for official use, communicating a given idea to suit different contexts. Letter writing – official letters and business letters; Report writing – importance of reports, preparing a report, technical report writing, project preparation and their presentation.

Module III
History of Science & Technology
The industrial revolution: Social changes after industrialization. The transportation revolution: History of bicycles, locomotives, ships, automobiles, aeroplanes and space vehicles.
The communication revolution: History of electricity, telegraphy, telephones, motion pictures, radio, television and modern communication systems.
Science, technology and society: Science and agriculture, science and religion; Transfer of technology, intermediate and appropriate technology; Gandhian approach to technology.

Module IV
Introduction to Psychology and behavioural sciences
Scope and methods of behavioural science and psychology. Basic psychological processes - perception, motivation, learning and retention. Psychology of individual differences- the concept of personality, measurement and assessment of personality
S-O-B model; a conceptual scheme for the understanding of work performance and behaviour of individuals and groups in the organisation context.

Module V
Industrial Psychology
Work design, Technology, and Human Behaviour – Job analysis, role analysis and work design, work measurement and O & M, human engineering and work environment.

Social psychology and the work situation – interpersonal relations- human relations, Hawthorne studies; Group dynamic – leadership, communication and morale; Management of change and management of conflicts.

References:
Rajendra Pal & J.S. Korlahalli; Essentials of business Communication, S.Chand & Sons, New Delhi
Gyani; Business communication, Jeevandeep Prakashan, Bombay.
Watt; Composition of Technical Paper, Mc Graw Hill
Encyclopaedia Britinica; History of Science, History of Technology
Brownoski.J; Science and Human values
Branal J.D; Science in History
Subbarayappa; History of Science in India
Stephen P. Robbins; Organizational Behaviour- Concepts, Controversies, Application, Prentince-Hall Pvt. Ltd., New Delhi, 1996
Fred Luthans; Organizational Behaviour, McGraw-Hill Inc. 1995.

ST 01 S1 MATHEMATICS I

1. Hyperbolic functions: Definitions, properties including formulae for arguments A± B; Inverses expressed as logarithms. Series for Cos hx, Sin hx, Mutual conversion of hyperbolic and circular functions.
2. Leibnitz's rule for $D^n(uv)$. Simple problems. Taylor's and MacLauren's series
3. Standard curves in engineering practice such as conics, cycloids, hypocycloids, catenaries. lemniseates, cardioids and others. Curvature, center of curvature of these. Tangents & normal
4. Envelopes and evolutes. The latter viewed both as loci of centre of curvature and envelope of normals
5. Partial derivatives. Total differentials. Euler's theorem on homogeneous functions. Errors and approximations.

Reference:
a) Kreyzig,E.; Advanced Engineering Mathematics, Wiley, New York.
b) Grewal,B.S.; Higher Engineering Mathematics, Khanna Publishers, New Delhi.

ST 01 S2 PHYSICS

1. Interference of Light: Interference on thin films, colours of thin films-Newton's rings (reflected system). Determination of wavelength and refractive index. Air wedge –diameter of thin wire-Testing of planeness of surfaces
Production of X-rays-continuous and characteristic x-rays-Mosley's law-Diffraction of x-rays-Bragg's law-Bragg's x-ray spectrometer-Compton effect-expression for change in wavelength.
2. Diffraction-Fresenel and Fraunhofer diffraction-Zone place-plane diffraction grating-Measurement of wave length-dispersive power of grating. Resolving power-Raleigh's criterion-Resolving power of telescope and grating.
Double refraction-Positive and negative crystals- Nicol prism-Huygen's theory of double refraction. Quarter wave and double wave plates. Production and analysis of plane polarised and circularly polarised light using crystal plates. Optical activity-Fresnel's theory-Specific rotation-Half shade polarimeter.

3. Coherence and Lasers: Spatial and temporal coherence-coherence length-spontaneous emission-stimulated emission- population inversion- CW & pulsed Laser, typical laser systems like Helium-Neon, Nd, YAG, Ruby, Semi-conductor lasers. Applications of lasers- Principle of holography-reflection and transmission type- Recording and reconstruction-Applications of holography-white light holograms.
Ultra sound waves-Production, properties and application
Recording and reproduction of sound- Magnetic tape recording-sound recording on cine films
4. Fibre optics and its applications: General ideas of optical fibre- NA of fibre-step index and graded index of fibres-multimode and single mode fibres-applications of optical fibres-fibre optic communication- optical fibre sensors-general ideas of integrated optics.
5. Crystallography and lattice planes: Crystallography-space lattice-unit cell-crystal systems-simple cubic-body centred and face centred cubes. Lattice planes and Miller indices-spacing between lattice planes-powder method for crystal study.
Dielectrics: Types and applications
Superconductivity: Transition temperature-Meissner effect-Isotope effect-Type I and type II-super conductors- B.C.S. theory (qualitative study)- High temperature super conductivity (General idea)- Josephson effect- SQUIDS.

Reference:
a) J.B. Rajan; Modern physics
b) Sathyaprakash; Optics and atomic physics
c) Thereja; Modern physics
d) Charles Kittel; Solid state physics
e) Agarwal; Optical fibre communication
f) Ajoy Ghatak; Optics
g) S.P. Nair & K.P. Jayaprakash; A text Book for Engg students

ST 01 S3 CHEMISTRY

1. Production of engineering materials – Production of steel – Bessemer converter process, open hearth process, electric furnaces, oxygen process, chemical additions to steels. Production of non-ferrous alloys – Production of aluminium and its alloys, Production of other non-ferrous alloys – bronze, brass, special reference to the requirements of shipbuilding (ships propellers etc). Plastics - formation of high polymers, thermoplastic and thermosetting resins, methods of fabrication of plastics, production of GRP-materials.
2. Electrochemistry – classification of conductors, electrolytes, conductance of electrolytes, specific and equivalent conductance, application of conductance measurements, Debye-Huckel model of electrolytic conductance and Onsager equation. Galvanic cells, EMF measurements, classification of electrodes, Nernst equation, electrode potentials, cell reactions. Relationship between cell potential and thermodynamic quantities. Electrochemical energy sources, lead acid battery, nickel cadmium battery. Fuel cells (H2/O2). Electrochemical corrosion and it application.
3. Fuels and Combustion – Solid, liquid and gaseous fuels, calorific value of fuels, calorific intensity, flue gas analysis. Coal – analysis of coal, carbonisation of coal, metallurgical coke and its manufacture, hydrogenation of coal. Petroleum – Origin and refining of petroleum, cracking and polymerisation, requisites of a good petrol.

Diesel oil, Petrochemicals, Gaseous fuels – natural gas, LPG, Producer gas, combustion zone, reduction zone, water gas, coal gas, oil gas. Combustion calculations, explosives. Propellants, Nuclear fuels – nuclear fission and fusion.
4. Lubricants – Mechanisms of lubrication, boundary lubrication, extreme pressure lubrication. Classification of lubricants, synthetic lubricants, properties of lubricant.
5. Water and its Treatment – Source of water, hard and soft water, determination of hardness, softening water – lime soda process, ion exchange. Boiler feed water – removal of oil, blow down operation, caustic embrittlement, internal conditioning. Water for domestic purposes – sedimentation, coagulation, filtration and sterilisation, chlorination and its advantages and disadvantages. Disinfection with Ozone. Desalination
Pollution – chemical characteristics, sewage treatment – biological oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon (TOC). Solid wastes, Water pollution, Air pollution, their control.
Reference:
a) Balasubramanian M.R., Krishnamoorthy S. & Murugesan V. " Engineering Chemistry" Allied Publishers Ltd.
b) Uppal, M.M.; A Text Book of Engineering Chemistry, Khanna Publishers, New-Delhi.

ST 01 E1 ENGINEERING MECHANICS I

1. Concurrent forces in a plane: Principles of statics, composition and resolution of forces, free body diagrams, equilibrium of concurrent forces in a plane, method of projections, equilibrium of three forces in a plane, method of moments, friction.
2. Parallel forces in a plane: Two parallel forces, general case of parallel forces in a plane, centre of parallel forces and centre of gravity, centroids of composite plane figures and curves, distributed force in a plane.
3. Properties of areas: Moment of inertia of plane figures with respect to an axis in its plane, moment of inertia with respect to an axis perpendicular to its plane, product of inertia, principal axis of three dimensional bodies.
4. General case of forces in a plane: Composition of forces in a plane, equilibrium of forces in a plane, plane trusses, method of joints and method of sections, plane frames, method of members, method of substitution and method of sections, funicular polygon, Maxwell diagrams, distributed force in a plane, flexible suspension cables.
5. Force system in space: Concurrent forces in space, method of projections and method of moments, couples in space, parallel forces in space, centre of parallel forces and centre of gravity, general cases of in space.
Principle of virtual work: Equilibrium of ideal systems, efficiency of simple machines, stable and unstable equilibrium.

(Note SI Units should be followed)

REFERENCES:
Timoshenko & Young: Engineering Mechanics
Beer F.P & Johnson E.R: Mechanics for Engines-Statics Dynamics
Shames I.H: Engineering Mechanics-Statics and Dynamics
Langhar H.L & Beresi A.P : Engineering Mechanics
Merriam J.L & Kraige L.G: Engineering Mechanics

ST 01 E3 ENGINEERING GRAPHICS

1. Introduction to Engineering Graphics: - Drawing instruments and their use, different types of lines-lettering and dimensioning, familiarisation with current Indian Standard Code of Practice for general engineering drawing. Simple geometrical constructions-Conic Sections-Construction of ellipse, parabola, hyperbola and rectangular hyperbola, cycloidal curves, construction of Archimedian spiral and logarithmic spiral drawing tangents and normals to these curves.
2. Introduction to orthographic projections: - Plane of projection-principles of first angle and third angle projections. Projection of points in different quadrants. Orthographic projection of straight lines parallel to one plane and inclined to the other planes-straight lines inclined to both the planes-true length and inclination of lines with reference plane-traces of lines. Projection of plane laminae of geometrical shapes in oblique positions.
3. Projection of plane figures – projection on auxiliary planes; Projection of polyhedral and solids of revolution- Frustum projection of solids with axis parallel to one plane or parallel or perpendicular to the other plane-projection of solids with axis inclined to both the planes-projection of solids on auxiliary planes. Section of solids by planes inclined to horizontal or vertical planes shape of sections.
4. Development of surfaces of prisms, cylinders, pyramids and cones, intersection of surfaces of prisms. Cylinders and cones.
5. Introduction to isometric projection: -isometric scale, isometric views, isometric projections of prisms pyramids cylinders, cones and spheres. Introduction to perspective projections one point, two points and three points perspectives-visual ray method and vanishing point method-perspective of circles, perspective views of prisms and pyramids.

Reference:
a) P.S Gill : Geometrical Drawing, B.D Ketaria Ludhiana
b) N.D Bhat : Elementary Engineering Drawing, Charolar Publishing House, Anand
c) P.I Varghese & K.C John : Engineering Graphics

ST 01 L1 WORKSHOP PRACTICE I

1. Fitting Shop
2. Carpentry Shop
3. Foundry Shop
4. Sheet Metal Shop
5. Lathe,
6. Shaping m/c, Planing m/c, Milling m/c, Drilling and Boring m/c

(Preliminary exercises for beginners in all shops. Specific models may be designed by the teachers)

SEMESTER II

ST 02 S1 MATHEMATICS II

1. Applied Integral Calculus. Areas, arc-lengths, volumes and surface areas of solids of revolution. Multiple Integrals; Jacobians.
2. Vector calculus, Cartesian, Cylindrical and Spherical systems of co-ordinates. Expression for ds^2, gradient, divergence, curl in all the three systems. Gauss theorem. Stoke's theorem.

3. Ordinary Differential Equations of the second order with constant coefficients, Euler-Cauchy type. Simultaneous Linear Equations.
4. Fourier series. Full range and half-range series. Maxima and Minima of functions of two variables Saddle points. Legrangian Multipliers.
5. Sequences and infinite series: Convergence and divergence. Radius of convergence, comparison tests, Raabe's test. Solution of first order and second order differential equations at regular points (Singular points not included)

Reference:
a) Kreyzig,E.; Advanced Engineering Mathematics, Wiley, New York.
b) Grewal,B.S.; Higher Engineering Mathematics, Khanna Publishers, New Delhi.

ST 02 S4 COMPUTER PROGRAMMING

1. Computer Fundamentals: Basic computer organisation, representation of information, secondary storage devices, systems and applications, software, operating system.
2. Overview of programming: Introduction to computer based problem solving, programs and algorithms, data organisation or data structures, construction of loops, use of procedures.
3. Fundamentals of C Programming: Data types – int, float, char, double and void, etc. Operators and expressions – Arithmetic operators, relational operators, logical operators and their expressions. Control constructs – if-then, for and while. Arrays – array declaration, one and two-dimensional arrays. Functions and subprograms – general form arguments and return values.
4. Advanced Programming techniques: Control constructs – do–while, switch statements, go to, label. Functions – parameter passing, call-by-value, call-by-reference, calling functions with arrays, argc and argv.
5. Dynamic Data structures: Pointers - & and * operators, pointer expression, pointer assignments. Structures – Basics of structures, referencing structure element, array of structures, passing structures to functions. File handling – file pointer, file accessing functions, fopen, fclose, putc, getc and fprint.

Reference:
a) Rajaraman; Introduction to Computers
b) Rajaraman; Computer Fundamentals
c) Kernighan, B.W.K. & Ritchi, D.M.; The C Programming Language; Prentice Hall of India, 1989.
d) Richard Johnson-baugh & Martin Kalin; Application Programming in C; Macmillan International Edition, 1990
e) Schildt, H.; C made easy; McGraw Hill Book Company, 1987.

ST 02 E1 ENGINEERING MECHANICS II

1. Rectilinear translation: kinematics of rectilinear motion, principles of dynamics, differential equation of rectilinear motion, motion of a particle acted upon by a constant force as a function of time, force proportional to displacement, simple harmonic motion – damped oscillations, forced oscillations, damped oscillations and forced oscillations with single degree of freedom.

2. D'Alembert's principle, momentum and impulse, work and energy, law of conservation of energy, ideal systems, impact.
Curvilinear translation: Kinematics of curvilinear motion, differential equations of motion, motion of projectile, D'Alembert's principle in curvilinear motion, moment of momentum, work and energy in curvilinear motion.
3. Rotation of rigid body about a fixed axis: Kinematics of rotation, equation of motion of rigid bodies rotating about a fixed axis, rotation under the act of a constant moment, compounds pendulum, general case of moment proportional to the angle of rotation D'Alembert's principle resultant, inertia force in rotation, principle of angular moment in rotation, energy equation for rotating bodies.
5. Plane motion of a rigid body: Kinematics of plane motion, instantaneous centre, equations of plane motion, D'Alembert's principle in plane motion, principle of angular momentum in plane motion, energy equation for plane motion.

References:
a) Timoshenko & Young; Engineering Mechanics
b) Beer.F.P. & Johnson.E.R.; Mechanics for Engineering Statics
c) Shames.I.H.; Engineering Mechanics-Statics and
d) Langhar.H.L. & Boresi.A.P; Engineering Mechanics
e) Merriam H.L & Kraige L .G; Engineering Mechanics

ST 02 E2 ELECTRICAL ENGINEERING AND ELECTRONICS

1. Units of electrical, mechanical and thermal quantities and their inter-conversion. Resistance, current, voltage and power in series and parallel circuits; Ammeters and voltmeters – range extension of ammeters and voltmeters; Star delta transformation-constant voltage source and constant current source.
Electromagnetic induction-Faraday's Law-Lenz's law –Dynamically and statically induced emf-self and mutually induced emf-coefficient of coupling inductance in series and in parallel.
AC Fundamentals: Generation of alternating voltage and current, equations of sinusoidal voltage and current. Wave form, cycle, frequency, time period, amplitude phase difference r.m.s value, average value, power factor, form factor-vector diagram using r.m.s values, addition and subtraction of vectors, sine waves in phase and out of phase, AC circuits- LC, RC, RLC circuits-series and parallel circuit. Resonance in RLC series and parallel circuits.
Network theorems: Kirchoff's laws-Network analysis by Maxwell's circulation currents-Thevenin's theorem-Superposition theorem – Norton's theorem-simple illustrative problem on network theorems.
2. Transformers: working principles and elementary theory of ideal transformer-constructional features of single phase transformer, emf equation-turns ratio-vector diagram-equivalent circuit- impedance transformation-transformer losses-flux leakage-efficiency-open circuit and short circuit tests-auto transformer-working principle. Basic idea of current transformer and potential transformer-distribution and power transformer-applications-standard ratings-Basic idea of three phase transformers.
D.C Generators: Construction Details-principle of operation-emf equation-methods of excitation-armature reaction-commutation-interpoles.
D.C Motors: Principle of operation-back emf-speed and torque equation-characteristics and applications of shunt, series and compound motors.

3. Polyphase circuits: Generation of polyphase voltage – phase difference- vector representation-comparison between single phase and three phase systems- star and delta connection- current, voltage and power in three phase systems- balanced and unbalanced three phase circuits- neutral shifting. Power measurements in three phase circuits using single watt meter and two watt meter methods.
Alternators: Construction details-principle of operation- type-emf equation (winding factor need not be derived) – synchronous speed.
Synchronous motors: Principle of operation and method of starting.
Three phase induction motor: construction details- types - production of rotating magnetic field, typical applications.
Single phase motor:- Single phase induction motor-single phase capacitor start capacitor run induction motors-series motor-applications of single phase motors.

ELECTRONICS

4. Band theory of solids –Conductors, semiconductors and insulators-energy band diagram-Semiconductor materials and their properties- doping – P type and N type semiconductors.
PN junction- energy band diagram-barrier potential, biasing PN junction, PN junction characteristics, Diode-capacitance, principle of zener and avalanche diodes-photodiodes, Rectifiers- Half wave- full wave- bridge – comparison- filters-regulated power supply.
5. Bipolar junction transistors-NPN, PNP types, Basic structures, current components in transistors –common base, common emitter and common collector configurations-characteristics- current gain- voltage gain- power gain-relations between alpha & beta. Active- saturation and cut off regions.
Audio amplifiers-positive feedback- oscillators- negative feedback.

References:
a) E. Hughes; Electrical Technology, ELBS
b) Streetman; Solid State Electronics Devices, PHI (I to IV)
c) Ramanan; Functional Electronics (V)
d) H.Cotton,; Advanced Electrical Technology, Wheeler Publications
e) Hygyesm; Electrical Technology, ELBS. Publications
f) Bimbra P.S; Electrical Machines,
g) Say M.G; Performance and Design of AC machines, ELBS.

ST 02 E4 MACHINE DRAWING

Introduction to theory of dimensioning, Types, size, location, functional and datum dimensions, principles for dimensioning (IS), dimension figures, notation of dimensioning.
Lines, symbols, figures, notes, arrow heads, etc., placing the dimensions, dimensioning angles, arrangement of dimensions, machining symbols and surface finish.
Simplifications and conventions-recommended abbreviations, use of symbols and abbreviations, conventions on machine drawing, conventional representation of threads, conventional lines.
Sectional views, section plane, section lining, full section, half section, partial or broken out section, off set section, removed or rolled section, auxiliary section,

aligned section, disposition of successive sections, partial views, developed view, part located in front of a cutting plane, assembly sectioning, sectioning conventions.
Conversion of pictorial views into orthographic views, orthographic reading or interpretation of views
Sketching
Drawing of machine elements:- keys, cotters & pin joints, rivets & riveted joints welded joints, screw threads and screw fastening, bearing, brackets and hangers, pipes and pipe joints, gearing springs.
Production drawing (types and uses):- Final lay out drawings, general arrangement, assembly drawings, sub-assembly drawings, detail process drawings.
Information on drawings:- material list, modifications, jigs and fixtures, weight, general tolerances, order number, material specifications, heat treatment, surface finish, general comments.
Limits and tolerances

Reference:
a) N.D Bhat : Machine Drawing, Charolar Publishing House, Anand.
b) P.I Varghese & K.C John : Machine Drawing

ST 02 N1 INTRODUCTION TO SHIP TECHNOLOGY

1. Historical review - ancient types of vessels (rafts, boats, and ships), the role of the ship in the ages of the great discoveries.
Types of ships-terms and definitions, cargo ships (general cargo ships, bulk carriers, container ships, Ro-Ro ships, barge carriers, tankers), fishing vessels, factory ships, supply ships, Cable ships, ice breakers, research vessels, warships, hydrofoils, air cushion vehicles, small pleasure crafts (yachts, ketches, etc)
2. Some physical fundamentals-Archimedes principle, laws of floatation stability and trim, forces acting on a ship (static condition in waves and during launching)
The ship's form-main dimensions, lines plan, coefficients and their meaning
3. The ship and her structural members-shipbuilding materials (properties, compositions), bottom structure, shell plating and framing, decks, hatches and hatch covers, superstructures, bulkheads, tanks, holds, fore and aft structure, stern and rudder.
4. Propulsion machinery-development of ship propulsion, general arrangement of propulsion plants, main engines (Diesel engines, steam engines & turbines, gas turbines, Diesel-electric drive, nuclear power plants)
Auxiliary machinery-power supply (current, steam, water etc), auxiliary engines for ship systems operation, auxiliary engines for engine plant operation, steering gear.
5. Outfitting-anchor, mooring and towing equipment, cargo handling equipment, rigging, life saving appliances and fire fighting equipment, heating, ventilation and air-conditioning, refrigeration plants, painting, accommodations
Bridge: The control centre of the ship-bridge arrangement and layout wheel house, navigation and communication equipments, methods of navigation, navigational lights

Reference:
Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
Rawson & Tupper; Basic Ship Theory

Tupper, E.C.;Introduction to Naval Architecture, Butterworth-Heinemann, UK, 1998.
Reed's Naval Architecture for Marine Engineers
Taggart; Ship Design and Construction, SNAME
D'Archangelo; Ship Design and Construction, SNAME.
Eyres, D.J.; Merchant Shipbuilding
Taylor, D.A.; Merchant Ship Construction, Butteworths, London

ST 02 L1 Workshop Practice II

1. Introduction to Welding Technology (Theory) – Historical review, classification of welding process, Gas welding, Manual metal arc welding, Submerged arc welding, Electro slag welding, Inert gas welding, Plasma arc welding.
2. Welding Practice – Arc welding, Gas welding, Gas cutting.

ST 02 L2 Electrical Engg. Lab.

1. Conduct the polarity test and ratio transformation of given single-phase transformer.
2. Conduct the open-circuit and short circuit tests on single-phase transformer.
3. Plot the following characteristics of DC series and Shunt motors:

* Efficiency against output
* Speed against torque
* Current against torque

SEMESTER III

ST 03 S1 MATHEMATICS III

1. Eigen values and Eigen vectors of a square matrix. Diagonalisation. Finding the nth power of a square matrix using eigen values. Ortogonal and Hermitian matrix. Theorems on the eigenvalues of these.
2. Laplace Transforms. Unit step function- Dirac Delta functions. Periodic functions. Inverse transforms. Laplace transform methods of solving Ordinary Differential Equation
3. Analytic functions of a complex variable. Cauchy-Riemann conditions. Harmonic functions. . Euler's formula for $e^{i\theta}$ and its uses in summation of series
4. Expectation, Variance and nth moments of the Binomial, Geometric, Poisson, Exponential and Normal variates. Moment generating functions
5. Partial Differential Equations of the form F(x,y,z,p,q)=0. Formation Complete, Singular and General Integrals. Clairaut's form. Charpit's Method

Reference:

Kreyzig,E.; Advanced Engineering Mathematics, Wiley, New York.
Grewal,B.S.; Higher Engineering Mathematics, Khanna Publishers, New Delhi.

ST 03 E5 FLUID MECHANICS I

1. Properties of fluid-ideal fluid-actual fluids-fluid pressure
2. Statics of fluids-Euler's condition of equilibrium-pressure under the action of gravity-constant velocity rotation around a fixed axis-fluid under pressure neglecting gravity-forces on walls of container-surface tension-atmospheric equilibrium

3. Fluids in motion-One dimensional flow-equation of continuity-Euler's equation-Bernoulli's equation-stagnation and total pressure-energy equation for unsteady flow-impulse and equilibrium
4. Influence of viscosity-generalised Bernoulli's equation-Newton's law of fluid friction-laminar flow-Poiseuille's flow-turbulent flow-Reynold's number-Prandtl's mixing length and Karman's suggestion in regard to the relationship between mixing length and wall distance-velocity distribution in turbulant plane flow-friction co-efficient
5. Pumps:- Reciprocating pumps, Air vessels, Rotodyanamic pumps, Velocity diagram.
6. Turbines:- Impulse turbine- Pelton wheel, Reaction turbine, Francis turbine, Kaplan turbine.

References:

Walther Kaufmann; Fluid Mechanics, Tata McGraw-Hill Publishing Co, Ltd.
Douglas, Gasiorek, and Swaffield; Fluid Mechanics-Pitman.
Daugherty & Franzini; Fluid mechanics with engg. Applications, International students edition Mc Graw Hill.
Dr. Jagdish Lal; Hydraulic machines, Metropolitan book Co., Delhi-
N.S.Govind Rao; Fluid flow machines, Tata Mc Graw Hill.
Vallentine; Applied hydrodynamics, Butter Worths, London
Massey; Fluid Mechanics, ELRS
K.L.Kumar; Engineering fluid mechanics, Eurasia publishing house, New Delhi
Herbert Addison; A treatise on applied hydraulics
A.J.Stepan of; Centrifugal and axial flow pumps, Wiley, New York.
D.G.Shepherd; Principles of turbo machinery, Mac Millan Publishing Co.

ST 03 E6 MECHANICS OF SOLIDS

1. Introduction-types of loads and stresses-definition of uniaxial, biaxial and triaxial state of stresses-displacements and deformations.
Tension, compression and shear-uniaxial stresses-Hooke's law of material behaviour - deformation, in stress direction-lateral deformation, Poisson's ratio-differential equation of displacement, boundary conditions-strain energy for uniaxial loading.
2. Biaxial tension and compression-stresses in thin-walled pressure vessels (cylindrical and spherical)-analysis of biaxial stresses-Mohr's circle for biaxial stresses, principal stresses for triaxial state of stress
3. Torsion of circular shafts-shear stresses, shear deformation, differential equation of the rotational displacement, strain energy.
4. Symmetrical Bending of beams- Shear force and bending moment diagrams, assumption of the technical theory of bending, strain and stress distribution, linearised moment-curvature-relation, differential equation of deflection (2nd & 4th order), boundary conditions, strain energy, oblique bending.
Transverse shear-shear stress-simplified deformations due to shear stresses-differential equation of the additional deflection caused by transverse shear-strain energy.
5. Combined loads-failures (fracture, yielding, loss of stability)-hypothesis of failure
Stability of beams-types of equilibrium, Euler's theory of buckling, approx. determination of Cr. load.

Reference:
a) Timoshenko; Strength of Materials, East-West Publications.
b) Popov; Engineering Mechanics of Solids, Prentice-Hall Publications.
c) Krishna Raju & Gururaja; Advanced Mechanics of Solids and Structures, Narosa Publications.

ST 03 E7 INSTRUMENTATION

1. Introduction
Classification of instruments-Standards and calibration-Errors in instruments and measurements-gross errors-causes and corrective measures-static errors-static performance parameters Dynamic errors-Theoretical analysis of dynamic errors-simple case-Ist order system-Statistical analysis of data and errors- probable error-selection of the instrument.
2. Displacement –Velocity, Acceleration and Torque measurements
Transducers-classification of transducers, selecting a transducer. Strain gauges- gauge factor-unbonded and bonded resistance strain gauges-resistance strain gauge bridges-temperature compensation balancing of bridges. Capacitive gauges. L.V.D.T. (Linear variable differential transformer) Piezo electric transducer-Measurement of torque-Dynamometers-Transmission type-Driving type-Absorption type. Measurement of velocity and acceleration-Siesmic transducers –spring mass type. Accelerometers-Potentiometer type-LVDT Type-Piezo electric type. Velocity transducers.
3. Pressure measurement
Moderate pressure measurement-elastic transducers-electric mechanical instruments. High pressure measurement. Vacuum gauges-MC Leod gauge-Pirani gauge. Dynamic pressure measurement
4. Temperature measurement
Non electrical methods. Solid rod thermometer, Bimetallic thermometer Liquid-in-galss thermometer. Electrical methods. Electrical resistance thermometer-Semi conductor resistance sensors (thermistors) Characteristics –applications-thermo-electric sensors (thermocouples) -Law of intermediate temperature-Law of intermediate metals-Construction-Compensating circuits. Radiation methods. Total radiation pyrometer-selective radiation pyrometer optical pyrometer.
4. Measurement of humidity and flow
Hygrometer-dew point methods-Industrial Psychrometer. Hot-wire anemometers-constant temperature and constant current methods-Laser doppler anemometer. Measurement of Liquid level-using Gamma rays, float, ultrasonic methods
5. Introduction to intelligent Instrumentation
Logic circuits - ADC (Analog to digital converter) DAC (Digital to analog converter). Display devices-LED (Light emitting diodes), LCD (Liquid crystal display) and CRT (Cathod ray tube). Digital instruments (Functional diagram)

References:
a) B.C. Nakra, K.K.Chaudhary; Instrumentation measurement and Analysis.
b) A.K.Sawhney; Electrical and electronic Measurements and instrumentation.
c) William David cooper; Electronic Instrumentation and measurement techniques.
d) B.S.Sonde; Transducers and Display systems.
e) Ernest O Doebelin; Measurement Systems.

f) James.W.Dally, William.F. Riley, Kenneth G. McConnell; Instrumentation for Engg. Measurement.
g) E.B. Jones; Instrument Technology – Vol.2. – On line analysis of Instruments.

ST 03 E8 APPLIED THERMODYNAMICS

1. Thermodynamics
Introduction: Basic definitions (System, Control volume, work, heat property, process etc.); Zeroth law of thermodynamics; Ideal gas- equation of state.

First law of thermodynamics

Closed system undergoing a cycle; closed system undergoing a change of state; Internal energy of a system; Expansion work; Process using ideal gas - constant pressure, constant volume, isothermal; adiabatic and polytropic process -work done and heat added in different process; First law applied to one - dimensional steady flow process, flow energy, steady flow energy equation (ID).

Second law of Thermodynamics

Different statements; Reversible and irreversible process; Corollaries of second law - Absolute temperature scale; Carnot cycle - Carnot engine, refrigerator and heat pump. Clauscius inequality and definition of entropy, change of entropy of an ideal gas.

Pure substance

Equilibrium diagram - T-s, p-V, p-T, h-s, etc.

2. Gas power cycles and I.C.Engines

Gas power cycles: Carnot cycle, Brayton cycle, Erricson cycle, Sterling cycle etc.; Air standard cycles- Otto- Diesel, Dual and Joule cycle; Evaluation of thermal efficiency and mean effective pressure

Internal Combustion engine

Classification of I.C. engines -Principle of operation of spark Ignition and Compression Ignition engines both two stroke and four stroke
Stages of combustion in S.I. and C.I. engines

Knocking and detonation-factors controlling knock and detonation, methods of preventing Knocking and detonation

3. Steady state Heat Transfer
Modes of heat transfer and their mechanisms.

Conduction- Fouriers law of heat conduction- Heat conduction through composite walls and cylinders

Steady state heat convection

Free and forced convection- Definition of Nusselt, Reynolds, Praudlt and Grashoff's number and their significance.

Estimation of convective heat transfer coefficient using empirical formula for free convection over horizontal and vertical plates and cylinders, forced convection thorough pipes.

Heat exchangers

Different types- Log mean temperature difference for parallel flow and counter flow heat exchangers.

Radiative heat transfer

Emissive Power- Stephan Boltzman law- Definition of black body, grey body, Emmissivity, Absorptivity etc.,Kirchoff's law of radiation.

Estimation of heat transfer by radiation for sample cases like infinite parallel planes infinite concentric cylinders, and concentric spheres

4. Refrigeration
Definition and purpose

Principle of operation of Simple vapour compression system. Representation on T.S. AND p-h charts .Estimation of coefficient of performance and refrigerant flow rate. Factors affecting coefficient of performance.

Absorption refrigeration system

Comparison with vapour compression systems. Principle of operation of vapour absorption system like Aqua ammonia system, Electrolux system, Lethium bromide absorption refrigeration system etc.

Steam jet refrigeration system-working principle
Refrigerants

Classification and designation- properties and requirements- Important refrigerants like NH3, CO2, Methyl chloride, Methylene chloride, Freons etc. Factors influencing selection of refrigerants. Secondary refrigerants.

5. Air conditioning principles
Definition and purpose.
Psychrometry- psychrometric properties of air- Psychromentric chart- Adaibatic saturation.
Psychrometric process

Sensible heating and cooling, Humidification and dehumidification, Cooling and humidification, Cooling and dehumidification- Heating and humidification, Heating

and dehumidification, Adiabatic mixing of air streams –cooling and heating load calculations

Summer and winter air conditioning – Estimation of the state of supply air to the conditioned space- Quantity of air supply etc for simple winter air conditioning systems.

Reference:
a) Nag, P.K.; Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.. 1998
b) Ballaney, P.L.; Thermal Engineering, Vol. I, Khanna Publishers, New-Delhi.
c) James P. Todd & Herbert B. Ellis; Applied Heat Transfer, Herper & Row Publishers, New York.
d) Holman, J.P.; Thermodynamics, McGraw-Hill-Internation Student Edition.

ST 03 N2 BASIC SHIPS THEORY

1. Lines Plan – fairing process – table of offsets
2. Integration rules – Trapezoidal rule; Simpson's rules (1-4-1, 1-3-3-1 and 5,8,-1 rule); 6 ordinate rule; Tchebycheff's rule; Areas, volumes and moments
3. Bonjean calculations and curves, sectional area curves.
4. Hydrostatic calculations and curves.
5. Buoyancy and weight of the ship
6. Watertight subdivision of ships – flooding calculation, Floodable length

Practicals:– Lines plan, Bonjean curves, Hydrostatic curves

Reference:
Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
Rawson & Tupper; Basic Ship Theory
Tupper, E.C.;Introduction to Naval Architecture, Butterworth-Heinemann, UK, 1998.

ST 03 L3 Fluid Mechanics Lab

Pressure measurements, Velocity and rate of flow measurements, Calibration of Venturimenter, Determination of Friction factor, Critical velocity and Reynold's number at steady pipe flow, calibration of small orifices and mouthpieces.
Determination of metacentric height of a floating model.

SEMESTER IV

ST 04 S1 MATHEMATICS IV

1. Solution of Linear Algebraic Equations by the methods of Gauss and Gauss-Jordan. Iteration methods of Jacobi and Gauss-Seidal. Relaxation methods
2. Regula-Falsi method and Newton-Raphson Method for non-linear equation in one variable. Horner's Method and Graeffe's Root squaring Method for polynomial equation.
3. Difference operators E, ∇, Δ and their inter-relations. Newton's forward and backward interpolation formulae. Lagrangian Interpolation; Numerical differentiation, centre difference operators δ and μ., central difference formulae

4. Numerical Methods for Ordinary Differential Equations. Taylor Series Method. Picard's Method. Runge-Kutta Method of the fourth order. Orders of errors to be mentioned, Milno's predictor corrector method.
5. Harmonic Analysis. Estimation of Fourier coefficients given values of a function at specific values in its domain. Difference formulae for partial derivatives (only two dimensions need to be considered). Numerical methods for solving parabolic and elliptic partial differential equations in Cartesian co-ordinates only as in conduction of heat in infinitely long plates and steady state temperature distribution in finite rectangular plates.

Reference:
a) Kreyzig,E.; Advanced Engineering Mathematics, Wiley, New York.
b) Grewal,B.S.; Higher Engineering Mathematics, Khanna Publishers, New Delhi.

ST 04 E5 FLUID MECHANICS II

1. General theory of two and three-dimensional flow:- Continuity equation, Euler's equation of motion, circulation, Stoke's integral theorem. Generalised Bernoulli's equation, sources, sinks, dipole, Flow with circulation, potential flow with rotational symmetry, hydrodynamical lift, Kutta-Joukowski theorem
2. Vortex motion- Fundamental concepts, vortex analogy to Biot-Savart's law, straight parallel vortex filaments, vortex sheets,
3. Viscous flow- Navier-Stoke's equations, Couette flow, Plane poiseuille flow.
4. Boundary layer theory- Prandtl's boudary layer equations, criterion for separation, Blasius solution, Skin friction, displacement thickness, momentum thickness, Turbulent boundary layer, Boundary layer control.
5. Airfoils- Lift, drag, circulation, pressure distribution-theory of thin airfoils, wings of infinite and finite span, circulation distribution. Cavitation

Reference:
Walther Kaufmann; Fluid Mechanics, Tata McGraw-Hill Publishing Co, Ltd.
Schlichting; Boundary Layer Theory.
Vallentine; Applied Hydrodynamics

ST 04 E10 ANALYSIS OF STRUCTURES

1. Continuous beams - Clapeyron's three-moment equation, Moment distribution method, Torsion of non circular sections, shear center of simple cross sections.
2. Strain energy methods – principle of virtual work, flexibility method, stiffness method, strain energy and complementary energy, Castiglianos theorems.
Introduction to theory of plasticity.
3. Matrix methods – flexibility and stiffness matrices – transformation matrices and its applications
4. Introduction to theory of thin plates, Pure bending of plates, Small deflection analysis of laterally loaded plates, Boundary conditions, Navier solution, Lavy's solution. Analysis of stiffened plates - orthotropic plate model and other methods.
5. Vibrations of continuous systems - vibration of strings and rods – vibration of beams – vibration of shafts.

Reference:
a) Timoshenko & Young; Theory of Structures, McGraw Hill Publications.
b) Reddy, C.S.; Basic Structural Analysis, Tata-McGraw Hill Publications.
c) Timoshenko & Young; Theory of plates, McGraw Hill Publications.
d) Krishna Raju & Gururaja; Advanced Mechanics of Solids and Structures, Narosa Publications.

ST 04 E11 MATERIAL SCIENCE

1. Introduction:- Role of materials in Technology-Historical development-Economy of material usage-Classification of materials.
2. Structure of Solid
Atomic structure –crystal structure-atomic packing in crystal-miller indices-Imperfections in crystals-Types of bonds-Bonding forces and energies - influence of bond type on Engineering properties-thermodynamics and kinetics in materials behaviour-diffusion-structure of metal, alloy, polymer and ceramic- strengthening mechanism in metal-metallography.
3. Phase transformation and Phase diagram
Solidification-nucleation-crystallisation-single crystal and poly crystalline materials-Polymorphism-Thermodynamic reasoning of phase diagram-simple phase diagram-phase rule-lever rule-methods used to determine a phase diagram-Isomorphous system – Eutectic – Eutectoid, preitectic phase diagram- Iron- Carbon system-Martensite formation-TTT diagram- Hardenability - Tertiary system.
4. Heat Treatment
Annealing-process annealing – Spheroidizing - Normalising-Quenching and Tempering process- Austempering – Martempering - Case hardening- Alteration of materials properties by casting, working, joining, sintering – Precipitation – Age hardening- recovery and recrystallisation.
5. Mechanical Properties of Materials and Testing
Elastic, plastic, viscoelastic deformation- Tensile test for metals, polymers, ceramic-Strain aging-fracture- brittle fracture-Griffith's criterion of brittle fracture- fracture toughness-Ductile- brittle transition in fracture- Hardness- fatigue- creep- testing of mechanical properties- Failure analysis and prevention- wear of metal- NDT.
Structural Materials
Classification of steel- different types of steel-Aluminium & Titanium alloys used in shipbuilding- Propeller materials- Selection of materials- Specification- classification society rules- National and International standards for different class of steels

Reference:
a) V. Raghavan-Material Science and Engineering , Prentice-Hall of India (P) ltd New Delhi.
b) Donald S Clark-Physical Metallurgy for Enginers, East West Press(P) ltd , New Delhi
c) A.G.Guy- Introduction to Materials science, McGraw Hill ltd, International Student Edition
d) Hanson-The Engineer's Guide to steel, Addision-wesley Pub. Company Inc.
e) Stephen .C.Dexter-Handbook of oceanographic engineering materials.

ST 04 N3 STABILITY OF SHIPS

1. Introduction :- Potential energy and equilibrium; Stability of ships - stable and unstable conditions (including submerged vessels); Stability terms; Equivolume inclinations - shift of C.O.B. due to inclinations, C.O.B curve in lateral plane, metacentre, pro-metacentre and metacentric radius, metacentric height, metacentric curve, surface of flotation, curve of flotation, righting moment and lever; Moments due to wind, shift of cargo, passengers, turning and non-symmetrical accumulation of ice; Effect of superstructure on stability
2. Transverse stability: - Form and weight stability – stability functions
Initial stability – GM0, GZ at small angles of inclinations, wall sided ships; Stability due to addition, removal and transference (horizontal, lateral and vertical) of weight, suspended weight and free surface of liquids; Stability while docking and grounding; Inclining experiment.
Large angle stability -Diagram of statical stability (GZ-curve), characteristic of GZ-curve, static equilibrium criteria; Methods for calculating the GZ-curve (Krylov, Prohaska, etc.); Cross curves of stability; Dynamical stability – diagram of dynamical stability, dynamical stability criteria.
3. Longitudinal stability – trim, longitudinal metacentre, longitudinal centre of flotation, moment to change trim, trimming moment; trim calculations – addition, removal and transference of weight, change of density of water
4. Damage stability – deterministic and probabilistic approach. Stability in waves.
5. Recommendations of classification societies and governmental authorities – Intact and damage stability rules.

Practicals:– Cross curves of stability and Diagram of statical stability (Kryloff's method); Floodable length calculations

Reference:
Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
Dynamics of Marine Vehicles

ST 04 N12 MARINE ENGINEERING I

1. Ships and machinery – design and selection considerations; Marine diesel engines – general engine principles, Low speed and medium speed diesel engines, Constructional features. Fuels -, fuel oil system-Scavenging and turbo charging. Starting and revising systems, controls and safety devices, governing; Lubrication, Lubricants and lub. oil systems, cooling systems-torque and power measurement, fuel consumption's characteristics, engine lead tests and general characteristics-Heat balance, waste heat recovery system.
2. Engine dynamics, torsional vibration of engine and shafting, axial shaft vibration, critical speeds engine rating, rating corrections, trial tests etc. Relationship of engine to the propeller classification society rules on engine construction. Engine room arrangement and engine-mounting study of different types of marine engines available in the world market.
3. Marine boilers types, fire tube and water tube boilers, boiler arrangements-steam to steam boilers, double evaporation boilers, exhaust gas heat exchangers, auxiliary

steam plant systems, exhaust gas boilers, composite boilers. Boiler mounting, combustion, feed system, feed water treatment. Feed pumps, condensers, air rejecters, deaerators, boiler operation, coal fired boilers.
4. Marine Steam turbines –Types of turbines, compounding-reheat turbines, turbine construction, rotors, blades, casing, Gland scaling, diagrams, nozzles, bearings etc. Lubrication systems, expansion arrangements, control, gearing operating procedure.
5. Marine gas turbines – fundamentals of G.T, Structure of gas turbines, gearing, operational features, controls, gearing, combined cycles.
Nuclear propulsion –physical principles of the operation of nuclear reactors – use of nuclear propulsion on seagoing vessels
Automation of ship propulsion plants
Maintenance requirements and reliability of propulsion plants.

Reference:
a) Harrington; Marine Engineering, SNAME Publications
b) Pounder,C.C.; Marine Diesel Engines, Newnen-Butterworths, London.
c) Reed's Marine Engineering for Naval Architect
d) Taylor, D.A.; Introduction to Marine Engineering

ST04 L4 MATERIAL TESTING LABORATORY
1. Standard tension test on UTM (Al or MS Rod)
2. Shear strength of MS rod on UTM
3. Deflection characteristic of open and closed springs
4. Determination of 'G' of wires using torsion pendulum
5. Hardness measurement – Brinell, Rockwell
6. Charpy and Izod impact tests
7. Maxwell's theorem and estimation of Young's modulus
8. Natural frequency and damping of cantilever beams
9. Stress concentration for a hole on a plate under tension using photo-elasticity

SEMESTER V

ST 05 S5 ENGINEERING ECONOMICS AND MANAGEMENT

1. Definition – nature and scope of economic science –economic relation between economic decision and technical decision-economic efficiency and technical efficiency.
Consumption-utility-diminishing marginal utility-indifferent map analysis
2. Production: Four factors of production and their peculiarities law of production-increasing-diminishing and constant return forms of business organisation-proprietorship - partnership joint stock company-division of labour-large scale production price mechanism: Demand and supply-elasticity of demand-different market structures-competition-monopoly –monopolist competition advertisement and product differentiation.
Distribution: Marginal productivity theory of distribution-modern theory of distribution, gross and net profit-theories of profit Rich theory-Ucerlamy theory – Innovation theory profit.
3. Systems concept, management control: power, authority responsibility and accountability; managerial functions conventional structures and relationships,

hierarchy; the hierarchy of objectives; management by objectives; different schools of thought in management.
4. Personnel Management: Recruitment, employment tests labour turnover; operator training; suggestion systems; industrial safety.
Wages and Incentives; feature of wages; time and piece rate different incentive plans; profit sharing; job evaluation and ranking; factors of comparison and point rating.
5. Marketing Management: Concept of marketing in sales approach product design, pricing decisions, distribution, promotion marketing researches test marketing, marketing of services advertising management.
Finance Management: Tasks, evolution of corporate management principles of accounting and finance statements.
Long term financing: Equity, preference and debenture capitals term longs: dividends and share valuation: legal aspects of dividends: short term financing; working capital; influencing factors, cash budgeting, terms of liquidity, management of receivable and inventories.

References:
a) R.R Borthwalk; Industrial economics(An introductory text)
b) Paul A Samuel; Economics-An Introductory analysis
c) Alfred W.Stonier and Double C Hagum; A Text Book of Economic Theory
d) Bethel el. al.; Industrial organisation and management
e) Kootnz Donnel; Principles of industrial management
f) Prasanna Chandra; Financial management, Tata McGraw- Hill

ST 05 E9 DESIGN OF MACHINE ELEMENTS

1. Fundamentals of machine design:-definitions, design process, design principles, design criteria; Stresses in machine parts-working stress, safe stress, factor of safety, endurance limits, fatigue factors
Elastic springs-classification and uses of springs-allowable stresses and deflections-design for fluctuating loads
2. Joints:- Principles of force transmission; detachable joints (pins, keys, splines, and bolted joints), Non-detachable joints; welded, soldered and glued joints, riveted joints; strength of welded and riveted joints.
3. Drive elements:- Shafts - torsion and bending of shafts, design of shafts for strength and deflection, effect of key ways, crank shafts.
4. Shaft couplings:- Rigid coupling (flange and compression couplings)-couplings with kinematics flexibility-slip couplings fluid couplings.
5. Bearings:- Slide bearings-introduction to lubrication, hydrodynamic bearings, bearing materials, design of slide bearings.
Roller bearings- types, static & dynamic load, capacity, bearing life and selection of Bearings.
6. Gears:- Types (spur and parallel helical gears) and function of gears, strength of gear teeth, stresses and stress concentration in gears-design of gears.

Practicals:- Design of a cast part, design and calculation of welded subassembly, design of a valve spring, design and calculation of a dynamically loaded screw joint, design and calculation of a shaft-boss joint (e.g. interference fit), design and drawing of a hydrodynamic slide bearing, design of gears on parallel axes.

Reference:
a) J.E.Shigley : Machanical Engineering Design, McGraw-Hill.
b) R.K.Jain, Machine Design, Khanna Publications, New Delhi.

ST 05 N4 RESISTANCE OF SHIPS

1. Components of ship resistance, Dimensional analysis.
Laws of comparison – geometrical, dynamical and kinematical similarity, Newton's, Froude's and Reynold's law, model-ship correlation

2. Viscous resistance – turbulent plate friction and plate resistance, viscous pressure resistance, separation and resistance due to separation, influence of curvature of the ship's hull, form factor, hull roughness and its influence on frictional resistance
Wave making resistance – pressure resistance, ship wave system, interference effects, theoretical calculation of wave making resistance, wave breaking resistance, bulbous bows and their effects

3. Model testing – tank testing facilities, testing, prediction of resistance from model tests, extrapolation, Froude's concept, laminar influence and tank wall effect, comparison of resistance prediction with results of full scale trials

4. Determination of resistance from series test results – residuary resistance, effect of hull form on resistance, Taylor series, Series 60, B S R A series, S S P A series, etc.; statistical analysis of resistance data, Guldhammer-Harvald's and Danckwardt's method. Resistance of planing crafts multi-hull vessels, hovercrafts, hydrofoils, barges and convoy of barges.

5. Air and wind resistance, Resistance of appendages, Added resistance in waves; Resistance in restricted waterways – resistance in shallow water, resistance in canals.

Practicals:– resistance calculation using Guldhammer and Harvald series, shallow water resistance calculation, model –ship correlation.

References:
a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
b) Harvald S.A.; "Resistance and Propulsion of Ships", John Wiley & Sons.

ST 05 N5 PROPULSION OF SHIPS

1. Propeller as a thrust producing mechanism; historical development; Screw propeller-screw propeller geometry, sections, propeller drawing, construction details.
Propeller theories-Momentum theory, Blade element theory, Circulation theory

2. Interaction between Hull and propeller- Wake and wake fraction, Resistance augment and thrust deduction factor, propulsive efficiency in open water and behind conditions, hull efficiency, quasi propulsive coefficient, transmission efficiency; Powering.
Cavitation-Types, Cavitation Number, Effects of cavitation, Prevention of cavitation, Design for minimum cavitation, Cavitation tests.

3. Design of propellers-Propeller families and series; Open water tests-Presentation of data, Kt-Kq diagrams, Design charts- Bp-?, ?-J, P-J charts, Use of charts in propeller design and performance study; Selection of engines-diesel engine characteristics.

4. Propeller strength- Materials and their qualities, strength calculation.
Model testing of propellers-Test facilities, Laws of comparison, open water diagram self-propulsion tests-British and continental Methods.

5. Shrouded propellers-Action of propeller in a nozzle, wake fraction and thrust deduction fraction in nozzles, load factor of nozzles, design of propeller-nozzle system, design charts.
Controllable Pitch propellers-Advantages, special features in geometry, design aspects.
Super cavitating propellers-application.
Other propulsion devices-Vertical axis propellers, Water jet propulsion, Sail, Paddle wheels, Electro magnetic propulsion etc.
Ship standardisation trials.

Practicals: – Propeller design using series diagrams

Reference:
a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
b) Barnaby K.; Basic Naval Architecture,

ST 05 N8 STRENGTH OF SHIPS I

Loads and Moments acting on ship structures:- Still water loads – physical loads-weight and buoyancy, buoyancy distribution, Determination of weight distribution, Determination of buoyancy distribution

Effects of physical loads: longitudinal and vertical bending and shear, determination of load curve, determination of S.F curve, determination of BM curve. Determination of deflection curve
Thermal loads

Loads and Moments due to oblique regular waves: - Vertical bending and shear - generation of longitudinal and vertical bending and shear, determination of wave BM (static wave).

Horizontal bending and shear – generation of horizontal bending and shear, determination of horizontal bending and shear.

Torsion - generation of torsional moments, determination of torsional moments.

Loads in a real seaway:- determination of wave loads (strip theory, etc.), representation of irregular seaway, sea spectrum, use of transfer function, determination of wave BM, determination of torsional moments

Probabilistic approach - short term distribution of loads, long term distribution of loads, probability of survival.
Additional load in a seaway – slamming loads shipping of green water.

Load calculation by classification society rules.

Analysis of ship structure: - longitudinal strength calculation, total bending moment, (Ms+Mw+Ms etc.), application of beam theory, hull girder section modulus.
Local strength assessment - secondary bending (bending of structures between transverse bulkheads), tertiary bending (bending of frames), plate bending (beam bending only)
Ring frame and grillages

Cargo handling system, Analysis of Mast-derrick system, analysis of shipboard cranes, analysis of Hatch covers.

Practicals: - Longitudinal strength calculation, Transverse strength calculation

Reference:
a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
b) Owen Hughes; Ship Structural Design
c) Muckle,W.; Strength of Ships.

ST 05 N12 MARINE ENGINEERING II

1. Marine and special duty pumps, Details of pumps for marine purposes viz. condenser circulating pumps, condensate and drain pumps, boiler feed pumps, bilge and ballast pumps – rotary pumps – ejectors: purpose of ejectors – details of construction.
Marine piping – various types of piping system fitted in ships, Expansion arrangements for pipes, valves, types used in Marine Practice. Materials and corrosion in pipes, colour codes for pipes.

2. Aux. systems-Air compressors, boilers, heat exchangers, cooling, evaporators, distillers, waste heat recovery systems, hot water, drinking water, cooling water and sea water systems.
Fuel systems, lubricating oil system-filters, coolers, centrifuges, purifiers and clarifiers.
Bilge and Ballast systems – Sewage disposal, Oily water separator, incinerator, galley equipment.

3. Deck machine and hull equipment – mooring, anchor handling, cargo handling-dry cargo handling equipment-winches, cranes, cargo gears, patent hatch covers, bulk heads, liquid cargo tanker cargo pipe layout systems-loading-unloading ventilation and cleaning of tankers, L.S.A. Boats & rafts, emergency equipment, water tight doors, stabilisers and bow thruster

4. Steering gears in marine use – different types – description construction, operation and maintenance.

Shafting arrangements stern tubes and glands-soil lubricated stern tubes – shaft seals-shaft alignment. Thrust block-reduction gearing.
Propulsion-types for marine propulsion, constructional details, fixing, maintenance and operation.
Ship stabilisers; Engine room cranes, chain blocks, tackles; Anchors, anchor chains.

4. Safety systems-fire fighting equipment
Instrumentation & control, watch keeping system UMS classes
Air compressors, heat exchangers.

Practical: Preparation of diagrams for various piping systems, steering gear, stern gear etc.

Reference:
a) Harrington; Marine Engineering, SNAME Publications
b) Pounder,C.C.; Marine Diesel Engines, Newnen-Butterworths, London.
c) Khetagurov, M.; Marine Auxiliary Machinery and Systems, Peace Publishers, Moscow.
d) Taylor, D.A.; Introduction to Marine Engineering
e) Reed's Marine Engineering for Naval Architect
f) Marine Pumps and Piping Systems,

ST 05 N13 ELECTRICAL SYSTEMS ON SHIPS AND SHIPYARDS

1. Components of electrical system on board ships, Standard voltages, difference between marine and industrial circumstances. Safety and quality of supply. Electrical power generation on board ships- Diesel generating sets, shaft driven generators, Turbo alternators, Brushless generators, specification of generators. Capacity calculation of main power plant -Diversity factor, single line layout of the DA set, protection for generators of main power plant, preference tripping -Installation rules for main power plant-emergency plant-layout of IC engine- driven & battery driven E.P.P. Switch gear for electrical system Fuses-Switches-relays- contactors- circuit breakers
2. Distribution systems:- Ring and radial system. AC single phase & 3-phase system-DC systems- Components of distribution system. MSB, SSB and DB -single line layout. Rules governing the distribution system. Regulations governing the installation of MSB. Special rules for tankers and fighting crafts – earthed and insulated AC systems- Transformers for power and lighting-. Specification of transformers- Specification of motors-speed based and torque based motors -DOL starter. Special regulation for installation of electrical system in steering system – rectifiers. Cables- specification of cables- testing of cables –current rating-design and selection of cables. Installation rules.
3. Electric propulsion –advantages-single line layout –Control of propulsion motors.

Light fittings- different sources of light-Types of light fittings- lighting arrangements in engine room, accommodation place, weather deck etc. Navigation lights - Installation rules for light fittings.

Navigational equipments: Auto pilot, magnetic compass, Log, Echo sounder and radar -rules-satellite navigation –RDF, Gyro Compass, LORAN – Aerials fitted on board ships.

4. Communication equipments: Modulation –amplitude modulation, Frequency modulation, modulation index –superhetrodyne receiver- Internal and external communication equipment. Installation rules -Domestic equipment –Engine room automation-fire detection.

5. Electrical system in shipyards: power factor improvement- power tariff calculation -essential regulations -main loads.

Practical : Preparation of Ship electrical system diagrams.

Reference:
a) Harrington L.Roy; Marine Engineering, SNAME Publications
b) Watson, G.O.; Marine Electrical Practice
c) Starr, A.T.; Generation, Transmission and Utilisation of Electrical Power
d) Sonnenberg,G.J. & Newnen Butterworth; Radar Electronic Navigation

SEMESTER VI

ST 06 E13 COMPUTER AIDED DESIGN & DRAFTING

1. Computer Aided Design and Drafting – An overview, Engineering design, designer vs computer; computer as a design medium- software tools, analytical tools, development of CAD software, programming language for CAD.
2. C++ and object oriented programming: Streamlining I/O with C++ - cin, cout, cerr, the >> extraction and << insertion operators. Reference variables – definitions, initialisation. Function overloading and default argument in functions. C++ structures – syntax rules. Object oriented programming – traditional structured programming, object oriented terminology, encapsulation and class hierarchy.
Classes: Introduction – member variables and functions, interfaces and implementations, construction and destruction. Derived class – single inheritance, multiple inheritance, access control, abstract class and polymorphism. Operator overloading – operator functions, function call, increment and decrement.

Computer Graphics and Geometric Modelling:

3. Introduction: Representing, preparing and presenting pictures, interacting with the pictures - description of various graphics devices.
Two Dimensional Transformations: Transformation of points and lines - scaling, reflection, shearing, rotation; Translation and Homogeneous co-ordinates; Combined transformations.
Three Dimensional Transformations: Scaling, shearing, reflection, rotation, translation, multiple transformations; Projections - Orthographic, axonometric, oblique, perspective projections.

4. Curve representation: Nonparametric and parametric curves; Plane curves - circle, ellipse, hyperbola, parabola; Space curves - Cubic spline, Parabolic blending, Bezier and B-Spline curves.
5. Surface representation: Surface of revolution, sweep surfaces; Piecewise surface representation - bilinear surfaces, ruled and developable surfaces, Bezier and B-spline surfaces.

Practical: Preparation of computer programs to understand various concepts and techniques included in the syllabus.

a) Krishnamoorthy, C.S. & Rajeev, S.; Computer Aided Design- Software and Analytical Tools, Narosa Publishing House, New Delhi, 1995.
b) Bjarne Stroustrup; The C++ Programming Language, Addison-Wesley Publishing Company, 1995.
c) Chris H. Pappas & William H. Murray; The Visual C++ Handbook.
d) Rojers, D.F. & Adams, J.A., Mathematical Elements of Computer Graphics, McGraw Hill International Editions.
e) Vera B. Anand; Computer Graphics and Geometric Modelling for Engineers; John Wiley & Sons, Inc.
f) Steven Harrington; Computer Graphics - A Programming Approach; Second Edition, McGraw Hill International Edition.
g) Donald Hearn and M. Pauline Baker; Computer Graphics; Prentice Hall International Eastern Economy Edition.
h) William M. Newman & Robert F. Sproull; Principles of Interacting Computer Graphics; McGraw Hill International Editions.

ST 06 N6 CONTROLLABILITY OF SHIPS

Manoeuvring Fundamentals – the control loop, path keeping, equations of motion, linearised equations and control fixed stability indexes, model tests.
Stability and control in the horizontal and vertical planes – definitive manoeuvres, turning trials.
Control surface hydrodynamics – geometry of control surface (rudder), flow around rudder, aspect ratio, influence of hull shape on aspect ratio, influence of fixed structures.
Control surface design - specification of requirements and constraints on rudder design, rudder location and orientation, number of rudders, type of rudder, geometric properties of rudder, maximum rudder deflection angle and deflection rate, rudder stock location.
Influence of ship features on controls fixed stability - fixed fin, propeller, hull, configuration
Experimental determination of hydrodynamic derivatives (rotating arm technique, planar motion mechanism).
Non-linear Manoeuvres, Simulation, IMO Rules and Recommendations

Practicals:- Calculation of free stream characteristics of rudder, Rudder design, Zigzag manoeuvre.
References:
a) Lewis,E.U.; “Principles of Naval Architecture”, (2nd Rev.), 1989, SNAME, New Jersey, U.S.A.

b) Abkowitz,M.A.; "Lectures on Ship Hydrodynamics – Steering and Manoeuverability", 1964, Danish Technical Press, Copenhagen, Denmark.

ST 06 N7 SHIP MOTIONS IN SEAWAY

1. Ocean Waves – Wind generated waves, regular wave theory, waves of Finite Height, Trochoidal Waves, Group Waves, Irregular Seaway, Point and Directional spectras, Wave Slope Spectra, Encounter Frequency Spectra, Idealised Spectral Families.
2. Ship in Regular Waves – Co-ordinate Systems, Equations of Motion (uncoupled Heave, Pitch and Roll; Coupled Heave and Pitch) Hydrodynamic Forces, Radiation Forces, Strip Theory.
3. Ship in Seaway and Dynamic effects – Linear Superposition, Response Amplitudes Operator, Pitch and Roll in Irregular Waves, Local and Relative Motions, shipping of green Water, Slamming, Yawing and Broading, Added Resistance, Powering in waves, Wave Loads.
4. Ship Motion Control – Control of Roll – Passive Stabilisers (Bilge Keel, Sails, Free Surface Tanks, U-tanks, Moving weight) Controlled – Passive Stabilisers, Active Stabilizers (fin, gyro, active-tank) Rudder Stabilisation, Control of Pitch.
5. Sea-keeping Performance and Design Aspects – Sea-keeping performance criteria and ship seaways responses, factors affecting pitching, heaving and rolling, guidelines for design, Sea-keeping features of high-performance ships (catamarans, SWATH, Planning Craft, Hydrofoil Craft, Air Cushion Vehicles and Surface and Surface Effect Ships, Submarines).

Practicals:- Estimation of Hydrodynamic coefficients, Heave, roll and pitch test in waves

References:
a) Lewis, E.U; 'Principles of Naval Architecture' (2nd Rev.) Vol. III, 1989, SNAME New York
b) Bhattacharyya..R; 'Dynamics of Marine vehicles', 1978, Wiley Inter Science, New York.
c) Lamb.H; 'Hydrodynamics', 1945, Cambridge University Press, UK
d) Newman J.N; 'Marine Hydrodynamics', 1977, MIT Press, USA
e) Newman J.N; 'Theory of Ship Motions', Advances in Applied Mechanics, Vol., 1980.
f) Price W.G & Bishop R.E.D; 'Probabilistic theory of Ship Dynamics', 1982, Chapman & Hall, London.

ST 06 N8 STRENGTH OF SHIPS II

Thin plates in ship structures: - loads, boundary conditions, bending of thin plates, analysis of stiffened plates (deck, side, bottom and bulkhead structures), buckling of stiffened panels, Submarine hull membrane and bending theory of cylindrical shells.
Torsion of ship's hull:- Analysis of Shear centre, flow calculation, Torsion of prismatic thin walled sections, Torsion of the ship's hull – torsional loadings on ship hulls – theory of restrained torsion – application of finite element methods – influence of deck transverses and ship ends

Application of plastic theory to ship structures:– basic introduction – safety factors, damage, collapse, ultimate longitudinal strength of a ship using classical methods and finite element method.
Introduction to vibration: – Sources of vibration, measures to control vibration, methods to determine natural frequency, Stodala iteration.
Misc. Topics:-
Strength of superstructure and deckhouses
Longitudinal strength during launching and docking

Reference:
a) Lewis, E.U; 'Principles of Naval Architecture' (2nd Rev.) Vol. III, 1989, SNAME New York
b) Owen Hughes; Ship Structural Design
c) Muckle,W.; Strength of Ships.

ST 06 N9 STRUCTURAL DESIGN OF SHIPS I

1. Introduction
Shipbuilding materials – transition from wood to steel (historical review), shipbuilding quality steels (properties, steel grades); Joining techniques – riveting, welding (butt joints, fillet joints, lap joints, welding symbols, weld strength); Ship structural design concepts – specialisation of the structure, general considerations in structural design, external loads (review), structural analysis models, design criteria, steps in structural design procedure, design from first principles, design according to classification rules.
2. Ship structural systems
Ship as stiffened plate structure – framing systems, common stiffener sections, corrugated construction, design of strakes (butts, seams), welding sequences, shell expansion; Structural subsystems – break up into bottom structure, side structure, deck structure, bulkhead structure, end structure, superstructure etc., general structural arrangements of different types of ships (historical review); subassembly, stiffened panels and volume sections.
3. Bottom structure and Side structure
Bottom structure – framing system, functions, single bottom and double bottom construction, structural components and scantlings, openings, cut outs, connection details, bilge keel; Side structure – framing system, functions, structural components and scantlings.
4. Decks and Bulkheads
Deck structure – functions, framing system, structural components and scantlings, hatch ways, pillars, bulwarks, guard rails, fenders; Bulkhead structure – type of bulkheads, functions, framing system, structural components and scantlings.
5. End structures
Fore end structure – functions, structural arrangements (panting), structural components & scantlings; Aft end structure – functions, structural arrangements, structural components & scantlings;
Structural connections – compatibility, bottom & side, side & deck, bulkhead with deck, side & bottom.

Practicals – Design of Bulk head, Midship section, Shell expansion

Reference:
a) Taggart; Ship Design and Construction, SNAME
b) D'Arcangelo; Ship Design and Construction, SNAME

ST 06 N10 SHIP DESIGN I

Introduction – General aspects of Marine Activities, Transportation of cargoes, Marine services & Operations, Marine Industries; Engineering Economics in Ship Design – Economic criteria, Initial cost, Operating cost, RFR; Owners requirements
Methods of ship design – design using basic type ships, Design using coefficients, Design using iteration methods; design spiral; design categories (dead-weight carrier, capacity carrier, linear dimension ship).
Ship parameters – displacement, displacement coefficient, displacement equation, volume equation, solution of the cubic equation
Ship dimension – length, breadth, depth, draught, form coefficients; Shape of the hull
Mass estimation - lightship mass – steel mass, outfit mass, engine plant mass; dead weight.
Design of hull form – conventional method of lines, distortion of existing forms; stem and stern contours, Bulbous Bow.
General arrangement - Subdivision of the ship's hull and erections, arrangement of spaces, arrangement of tanks, superstructure and deckhouses, arrangement of engine plants, Cargo handling capacity
Hold capacity and stowage factor.
Effect of from on Ship's performance: Freeboard and load line regulation; Stability – stability booklet, IMO Regulations, Checks on stability, trim.
Watertight integrity; damage stability, Tonnage measurement – international, Suez, Panama.
Behaviour of ships in sea
Resistance, Powering, Propulsion

Reference:
a) Lewis, E.U; 'Principles of Naval Architecture' (2nd Rev.) Vol. III, 1989, SNAME New York
b) Schneekluth, H; Ship Design for Efficiency and Economy, Butterworths, 1987
c) Taggart; Ship Design and Construction, SNAME

ST 06 N11 SHIP PRODUCTION I

1. Introduction to shipbuilding:– Structure of the shipbuilding process, special aspects of transport in shipbuilding, principles of flow line production in shipbuilding – mechanisation, automation, numerical control, computer control, trends of future development; Relations with supply industry, pattern of the shipbuilding, location and layout of shipyards, area, labour and other sources, coastline etc.
Data generation for shipbuilding process – generation of hull forms, generation of frame plan, shell plate development, generation of hull components, lofting, nesting.
Storage and preparation of material – Introduction, material handling and storage, transport system in steel stockyard, material preparation (straightening of plates and

rolled sections, shot blasting, prepainting), material preparation flow line devices and their control systems
2. Fabrication of component parts:– the cutting process – tools, physical-chemical background of the cutting process, mechanical cutting, devices for thermal cutting, general description of the various machines, photoelectric and NC-control devices, edge preparation, problems of accuracy; Bending of rolled and built up sections - general description of bending, control of the bending process, automation of bending; Plate bending, uniaxial bending, biaxial bending (devices, cold bending, heat-line bending), possibilities of automated plate bending.
3. Assembly of Ship's Structures: Prefabrication – general remarks, basic problems of prefabrication, pattern of prefabrication, welding in prefabrication
Sub-assemblies: built up T-bars, web frames, machine foundations etc.; welding deformation and straightening; Prefabrication of flat sections – panels, panel production line, preassembly of biaxial stiffened panels – welding procedures. Assembly of flat corrugated sections, flat sections with curvature – assembly jigs, welding process, its nature, theoretical background, strengthening of flat sections. Preassembly of volume units – Preassembly of double bottom sections – different structural arrangements, variants of the assembly process, welding problems; Preassembly of side tank units – structural arrangement; Special assembly systems (ROTAS, GAMMA-Systems, etc.); Preassembly of the fore and aft end structure; Preassembly and outfit of superstructures.
4. Erection of ship's hull – General assembly methods, handling of preassembled units in the erection area – cranes, heavy-duty truck; Preassembly of blocks – special types, advantages and disadvantages; Hull assembly – different methods of hull assembly, auxiliary devices; Welding in ship's hull assembly – welding methods applied, welding defects, welding deformation of the ship's hull; Quality control (X-ray tests etc),; Scaffolds
5. Launching – General methods, Launching by floating off (building dock, launching dock, floating dock), Mechanical launching methods (slip, lift), Launching from inclined building berths – stern launching, side launching; Launching calculations, model and large scale-experiments.

Practicals – Calculation of the process of frame 4bending, Subdivision of a ship into preassembled units, Erection sequence of a ship.

Reference:
a) Taggart; Ship Design and Construction, SNAME
b) Storch R. Lee, Hammon C.P. & Bunch H.M.; Ship Production, Cornell Maritime Press, Maryland, USA, 1988
c) Dormidontov V.K. & et.al.; Shipbuilding Technology, Mir Publishers, Moscow.
d) Eyres D.J.; Ship Construction William Heinemann Ltd, London, 1982

ST 06 L5 MARINE HYDRODYNAMICS LAB
Model test to predict ship resistance, flow line test, shallow water resistance test.
Open water test, self-propulsion test, bollard pull test.
Seakeeping tests

ST 06 L6 MARINE ENGINEERING LAB
1. Energy balance of a Diesel engine

2. Determination of the characteristics of diesel engine.
3. Determination of the characteristic curves of compressors.
4. Determination of the characteristic curves of pumps and pipings.

SEMESTER VII

ST 07 E12 PRODUCTION MANAGEMENT AND OPERATION RESEARCH

1. Production system-The systems approach-subsystems, comprehensive system model – the firm as a system
2. Managerial decision making-decision theory under certainty and uncertainty-models as decision aids-the decision process-problems, types and decision approaches
3. Decision of productive systems-product line determination, product planning, demand forecasting, steps and techniques-capital planning-demand and supply of capitals-capital allocation methods-investment criteria-value analysis and break even analysis-plant location and layout-factors-site selection-process and product layout-material handling systems-types, equipments, operating effectiveness in the productive system.
4. Operation planning and control-production inventory system-the inventory problem-functions of inventory-inventory costs-inventory concepts, models-production planning and control-pre-production activities-planning-scheduling-network models (PERT,CPM)-quality control-maintenance analysis
5. Some analytical techniques of operation research-introduction-basic concepts of OR types of mathematical models-linear programming-formulation of linear optimisation models-distribution methods-simple method-waiting line theory-models-examples

Practicals:-Linear programming applied to a problem of the production process-Application of network models with critical path scheduling-distribution problem-waiting line problem.

Reference:
a) Elwood S.Buffa; Modern Production/Operations Management, Wiley Eastern Ltd.
b) Richard J. Hopeman; Production – Concepts, Analysis, Control, 3rd Edition, Charles E. Merril Publishing Co.
c) Arthur C.Laufer; Operations Management, South-Western Publishing Co.
d) Khanna, O.P.; Industrial Engineering and Management, Dhanpat Rai Publication.
e) Richard I. Levin, et.al.; Production/Operations Management: Contemporary Policy for Managing Operating Systems, Tata-McGraw Hill Publishing Co. Ltd.

ST 07 N9 STRUCTURAL DESIGN OF SHIPS II

1. Engine Room – functions, general arrangement, engine casing, foundations, structural design of engine rooms.
2. Superstructure and Deckhouses - functions, structural arrangement, effectiveness of superstructure & deckhouse, structural design, opening and expansion joints.
3. Cargo handling equipment – different cargo handling system, mast derrick system, loads on mast derrick system, design of mast derrick system, deck cranes.
4. Hatch Covers – functions, load on hatch covers, statutory requirements, types of hatch covers, cleating & sealing arrangements, structural design of pontoon covers.

5. Miscellaneous topics – construction of life boats, submarine structure, chain locker, hawse pipe, rudder types & their construction, nozzles, stern tube & shaft bossing.

Practicals – Design of fore or aft end structure, Structural design of a rudder, Design of machine foundations, superstructures etc.
Reference:
Taggart; Ship Design and Construction, SNAME
D'Arcangelo; Ship Design and Construction, SNAME

ST 07 N10 SHIP DESIGN II

1. Standardisation – Process and product standard; Rules and regulation.
2. Cargo handling equipments, cargo hatches, lifting devices; Anchor installations – types of anchors, anchor handling system, anchor chain & storage; Mooring systems – deck fittings & structural arrangement, mooring machinery, mooring operations.
3. Accommodation – crew size, accommodation standards, space allocation, habitability, access, materials, standardisation and modular arrangement; Access equipments –hatches, manholes, doors, other closing & opening devices, load line rules, gang ways and ladders
4. Steering gear – Types, design aspects, connections; Mast & riggings; Railings & awnings; Sound and light signals.
5. Equipments in tanks & holds – Air vents, sounding tubes, cleaning devices, fire protection devices
Life saving system – life saving equipments, IMS international rules
Fire fighting systems – Rules and regulations, equipments, fire fighting
Ventilation, Panelling & deck covering, Painting.

Reference:
Taggart; Ship Design and Construction, SNAME
Cargo Handling Systems in Ships
Rules & Regulations – IMO, SOLAS, IMS
Venugopal K.; Maritime Law of India, Law Publishers, India
ISO 9000 Series
BSI – Indian Codes

ST 07 N11 SHIP PRODUCTION II

1. Outfitting of ships:– workshops –piping shop, fitters shop, Carpenters shop (wood, plastics), Mechanical workshop, Machine shop (preassembly of blocks), Other workshops (electrical installation, painting, insulation, etc.); Technological process in the hull installation work –Technological process in installing the main machinery, installation of shafting and propeller, installation of the main machinery, installing of auxiliary machinery and boilers, installation of piping systems, electrical installation, hull installation work; Pre and advanced outfitting.
Trial trip
PRODUCTION PLANNING AND CONTROL IN SHIPBUILDING
2. Production design – application of the principles of design for production in shipbuilding – joining of parts, relations between structural design and prefabrication, simplifications in structural design (design for welding), quality control.

Problems of accuracy – tolerances, standards, measuring techniques (theodoilite laser, etc); quality control
3. Process planning in shipbuilding:- Planning for operations – interconnection between production design and process planning, production and process analysis, assembly charts, operation process charts, flow process charts; Process selection. Application of models for process planning, scheduling and control – Gantt charts, CPM & PERT, transportation models etc.; Special aspects of application of these in shipbuilding process.
4. Capacity planning – estimation of future capacity of a shipyard methods, strategies for modifying capacity, models for capacity planning under the special conditions of shipbuilding.
5. Production Standards – production standards in several parts of the ship production process, work measurement systems, methods of man-hour determination, use of computers, correlation between size of series and needed man-hours.
Systems of maintenance and quality control.

Practicals – Launching calculation, Shell plate development & Nesting, Application of Gantt-charts and network techniques, Design of a panel-line and capacity calculation, Design of a special part of a shipyard layout (e.g. steel stockyard, dry-dock)

Reference:
a) Taggart; Ship Design and Construction, SNAME
b) Storch R. Lee, Hammon C.P. & Bunch H.M.; Ship Production, Cornell Maritime Press, Maryland, USA, 1988
c) Dormidontov V.K. & et.al.; Shipbuilding Technology, Mir Publishers, Moscow.
d) Eyres D.J.; Ship Construction William Heinemann Ltd, London, 1982

ST 07 N14 JOINING TECHNIQUES IN SHIPBUILDING TECHNOLOGY

1. Definition, Historical Background, Electric arc welding, Development in Welding, Science of Welding
Welding Metallurgy: Introduction, Structure of metals, Crystallisation of a pure metal, Equilibrium of constitutional dig., Phase transformation in Iron - Carbon diagram, Weldability of steel, Presence of alloy elements, Effect of welding process & nature of base metal, Preheating, HAZ.
2. Gas metal arc welding – Process, different metal transfers, power source, electrodes, shielding gas, uses of Gas in metal arc welding
Mechanised system in shipbuilding - Introduction, philosophy of automation in welding, different welding systems in shipyards, Welding in production shop – SAW, Gravity welding, Auto contact, CO2 Welding
3. Panel line production - One-sided welding – SAW, MIG welding, welding of stiffeners
Welding in building berth - External welding on the berth, Electro-slag welding, Electro-gas welding, One-sided welding (Flux Asbestos backing, Ceramic backing etc); Internal welding on the berth.
Comparison of European, Japanese & Indian Welding Process
4. Welding problems - Weld defects, Distortion, Accuracy control; Non destructive tests.

Welding quality control - Welding standards, Welding procedure qualification, Effect of variables on qualification of tests, Performance qualification of Welders & operators, Test reports, Acceptance standards, Quality assurance and audit, Consumable classification & coding.
Introduction to Robotic Welding.
5. Structural Adhesive Bonding as a joining technique – Adhesives and adherands, bonding methods and joint design, analysis of joints for strength, surface preparation for steel, aluminium and other materials used for marine structures.

Reference:
Davies, A.C.; Welding, Cambridge University Press, Low Price Edition, 1996.
Richard, Little; Welding Technology, McGraw Hill Publications, New Delhi.
Joe Lawrance; Welding Principles for Engineers, Prentice-Hall Inc. Englewood Cliffs, N.J.
Welding Handbook – Vol.:1,2,3; American Welding Society
O.P. Khanna; A Textbook of Welding Technology, Dhanpat Rai & Sons.

ST 07 NEA1 ELECTIVE I

COMPUTER AIDED SHIP DESIGN

1. Numerical Techniques in Computer Aided Ship Design:
Numerical Interpolation: Differences, Newton's Forward Difference interpolation formula, Lagrangian Interpolation formula
Numerical Integration: Integration formulas,
Curve Fitting: Fitting of Polynomials, Least Square curve fitting technique, Choosing the degree of the polynomial, Ill-conditioning difficulties, Orthogonal Polynomial fitting
2. Lines Design and Fairing:
Manual Graphical method
Computer Aided Curve fitting Techniques
Fairing Principles
Spline Fitting: Cubic Spline curve, Bezier Curve, B-Spline Curve.
3. Preliminary Ship Design
Design Stages and methods
Preliminary Parameter Estimation: Displacement, Length, Breadth, Depth, Draught, Block
Coefficient; Check on Transverse & longitudinal Stability, Freeboard, etc., Estimation of Power,
Capacity; Basic Ship Method
Computer Aided Preliminary Ship Design: Preliminary Parameter Selection, Ship Lines fairing
4. Database Systems
Introduction
Architecture of a Database system
Data Models: Relational, Hierarchical, Network
Application to Ship Design
5. Optimisation Methods in Ship Design, Introduction, Modeling of Design as Optimisation
Different Optimisation Methods; Linear and Non-liner optimisation

Application to Ship Design
Practical: Development of relevant Computer Programs based on the syllabus
Reference:
g) L.R Reheja, et.al.; Computer Aided Ship Design, Code No. 77, Update for Working Professionals, AICTE,
Continuing Education Programme
h) Chengi Kuo; Computer Methods for Ship Surface Design, Longman, 1971
i) Chengi Kuo; Computer Applications in Ship Technology, Heyden & Son Ltd. 1977
j) H. Nowacki, et.al.;Computational Geometry for Ships, World Scientific Publishing Co. Pvt. Ltd., 1995
k) David F. Rogers

ST 07 NEA2 ELECTIVE II

SHIP BUILDING MATERIALS, CORROSION PREVENTION AND PROTECTION

1.Introduction- Corrosion in nature, Corrosion losses, importance of corrosion protection, theories of – corrosion- electrochemical series- types of corrosion - its identification-remedies-factors affecting corrosion-fouling-effect of fouling on ships-factors affecting growth and settlement.
2.Corrosion control -Weathering steel-stainless steel-Titanium and Nickel alloys-copper and copper based alloys-Zinc-Aluminum and its alloys-corrosion control by Design, corrosion inhibitors-corrosion monitoring-corrosion management in ships.
3.Surface preparation -Degreasing-weathering-mechanical surface cleaning-pickling-blast cleaning-flame cleaning rust converters-chemical pretreatment-comparison of pretreatment methods.
4.Marine paints -Role of constituents of paints-classification of paints-mechanism of anticorrosive paint-paint types –selection of paint-paint scheme-antifouling paints-principles of antifouling paints -coating failure.
5.Cathodic protection -Mechanism of cathodic protection, sacrificial anode, design of sacrificial anode system for ship, impressed current system, advantages and disadvantages of cathodic protection.

REFERENCES:
Fontana M. G, Greene N. D, ‘Corrosion Engineering’, McGraw Hill, 2nd Edition, 1978
Raj Narayan, ‘An Introduction to Metallic Corrosion and its Prevention’, Oxford and IBH,1983
Jones D. A, ‘Principles and Prevention of Corrosion’, 2nd Edition, Prentice-Hall, 1965
T. Howard Rogers “Marine Corrosion” first Edition, George Newnes Ltd London, 1968

SEMESTER VIII

SPECIAL PROBLEM AND SEMINAR
Students can be given small projects that are relevant to Naval architecture, Marine Engineering and other Engineering fields and accordingly a seminar can be conducted.

ST 08 NEB1 ELECTIVE III

EXPERIMENTAL TECHNIQUES ON SHIPS AND MODELS

1. Ship Resistance tests, Total resistance, Resistance diagrams, Resistance Coefficients, Ship Models, Laws of comparisons and Similarity, Extension of Model results to Ships, Towing Tank, Instrumentation, Method of measurements.
2. Open water tests, Objectives, Facilities, Test set up, principles, procedure, Analysis and conclusions.
3. Cavitation, Cause of Cavitation, Cavitation number, Classification of Cavitation, Law of similarities, Cavitation tests, facilities, prevention of Cavitation.
4. Self Propulsion experiments, Objectives, Instruments and equipments, Test arrangements, basic principles, experiment, Results.
5 Sea trials, Shop tests, various sea trials, manoeuvering trials, Dock trials, Speed Trials, Observations, Data presentation and uses.
6. Shallow water resistance tests
Wake measurements, Sea keeping tests
Model Tests for Determination of Hydro dynamic derivatives of Ships and submerged vehicles.
Paint erosion tests, Smoke disposal tests, Redder tests, Tuft tests

ST 08 NEB2 ELECTIVE IV

SHIP REPAIRING AND SURVEYING

1. Repair of ship hull – Introduction; cause of wear and damage in ships hull: Comparison between different types of repair activities (Afloat, berthed, etc.); Repair of hull and other parts while afloat; docking plan-replacement of hull plates and stiffeners, decks and bulkheads; repair of stem and stern frames and shaft bracket; NDT and X-ray tests; Testing for water-tightness and hull continuity etc;

2. Underwater welding – welding equipment; quality control and standards; degree of automation;
Safety during repair – various operations involving risk; safety devices and plans; problems during docking;
Ship repair facilities in a modern repair yard-repair docks, machine shop, scaffolding; Subcontracting policies
by shipyard in repair project, layout of repair yard.

3. Various types of marine surveys.
Roles and responsibilities of marine surveying agencies;
Historical development of ship classification societies; Major activities of classification societies; rules and
class notation; IACS and joint projects;
Comparison of ship class rules by LRS and ABS;

4. International Ship classification societies and UN agencies involved in marine and offshore activities.

Activities of classification societies and surveying agencies bodies;
Classification society – Design approval; construction survey; survey on operation, repair conversion.
Industrial surveys, third party accreditation.
5. Statutory surveys – role of MMD. Activities of statutory bodies – MMD, Inspectorate of boats – design
approval; construction inclination experiment, keel sighting, registration, surveys during – repair conversion

PROJECT WORK
Students shall do independent Ship Design Project work. After completing the project, a project report shall to be prepared and submitted by each student.

VIVA VOCE