Bharathiar University: Coimbatore 641 046

Bachelor of Science (Marine) Degree Course (Four years)

For the candidates admitted during the academic year 2010-2011 onwards
(Centre for Participatory and Online Programmes)

Scheme of examination - CBCS Pattern

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@ No University Examinations. Only Continuous Internal Assessment (CIA)
# No Continuous Internal Assessment (CIA). Only University Examinations.
SEMESTER: I - ALLIED PAPER I

MARINE MATHEMATICS-I

UNIT I MATRICES

Characteristic equation - Eigen values and eigenvectors of a real matrix - Properties of Eigen values - Cayley - Hamilton theorem - Orthogonal matrices - Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY:

Direction cosines and ratios - Angle between two lines - Equation of a plane - Equation of a straight line - Co - Planer lines - Shortest distance between skew lines - Sphere - Tangent plane - Plane section of a sphere - orthogonal spheres.

UNIT III GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS

Curvature - Cartesian and polar coordinates - Circle of curvature - Evolutes - Envelopes - properties of envelopes.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES

Functions of two variables - Partial derivatives - Total differential - Differentiation of implicit functions - Taylor’s expansion - Maxima and Minima - Constrained Maxima and Minima by Lagrangean Multiplier method.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS

Linear equations of second order with constant and variable coefficients - Homogeneous equation of Euler type - Method of variation of parameters.

TEXT BOOKS

SEMESTER: I  CORE PAPER I

PHYSICS-I

UNIT I  PROPERTIES OF MATTER

Elasticity -stress - strain diagram - factors affecting elasticity - twisting couple on a wire-shafts-
Torsion pendulum - Depression of a cantilever - Young’s modulus by cantilever - Uniform and
non uniform bending - I shape girders - production and measurement of high vacuum - rotary
pump diffusion pump - Pirani Gauge - Penning gauge viscosity - Oswald viscometer -
Comparison of viscosities.

UNIT II ACOUSTICS

Acoustics of buildings - Absorption co efficient - Intensity - Loudness - Reverberation time -
Sabine’s formula - Noise pollution - Noise control in a machine - Ultrasonic’s - production -
Magnetostriiction and Piezoelectric methods - Applications of ultrasonic’s in Engineering and
medicine.

UNIT III  HEAT AND THERMODYNAMICS

Thermal conductivity - Forbe’s and Lee’s Disc methods - radial flow of heat - Thermal
conductivity of rubber and glass - Thermal insulation in buildings - Laws of Thermodynamics -
Carnot’s cycle as heat engine and refrigerator - Carnot’s theorem - Ideal Otto and Diesel engines
- Concept of entropy - Entropy - Temperature diagram of Carnot’s cycle.

UNIT IV OPTICS

Photometry - Lummer - Brodhum photometer - Flicker Photo meter -Antireflection coating - Air
and Transmitted Beam - Michelson’s Interferometer and its applications – Photo elasticity and its
applications.

UNIT V  LASER & FIBRE OPTICS

Principle of lasers - laser characteristics - Ruby – Nd YAG, He-Ne, CO2 and semiconductor
lasers - propagation of light through optical fibers - types of optical fibers - Applications of
optical fibers as optical waveguides and sensors.

TEXT BOOKS

1. Arumugam M “ Engineering Physics, Anuradha Agencies
2. Arumugam M “ Material Science” Anuradha Agencies
3. Text Book of Physics - Brij Lall & N. Subramanyam
SEMESTER: I  CORE PAPER II

MARINE CHEMISTRY-I

UNIT I  ELECTRO CHEMISTRY

Types of electrodes and cells - Reversible and Irreversible cells - Nernst Equation - EMF measurements and its application - Electro motive Series - electro winning - Metallurgy - applications - sensors - electrochemical machining - metal processing - principles of chemical and electrochemical corrosion - corrosion control (Sacrificial anode and impressed current methods)

UNIT II  WATER TREATMENT

Water quality parameters - definition and expression - estimation of hardness (EDTA - method) - alkalinity (titrimetry) - water softening (zeolite) - demineralization (ion-exchangers) and desalination (RO) - domestic water treatment.

UNIT III  POLYMERS

Monomer - functionality - degree of polymerization - classification based on source and applications - addition, condensation and co polymerization - mechanism of free - radical polymerization - thermoplastics and thermosetting plastics - processing of plastics - injection molding, blow molding and extrusion process - Commodity and engineering plastics - polymer blends and alloys - molding compounds - powder, DMC, SMC, liquid resin - composites - fibers ceramic - glass.

UNIT IV  CHEMICAL THERMODYNAMICS

Definition of enthalpy, entropy, free energy and spontaneity - Maxwell relations - Gibb’s - Helmholtz equation - Van’t hoff equation - stoichiometry and energy balances in chemical reactions.

UNIT V  DYNAMICS OF CHEMICAL PROCESS

Basic concepts - composite reactions (opposing, parallel and consecutive reactions) - collision theory - thermodynamic formulation of reaction rates – unimolecular reactions - chain reaction (stationary and non-stationary) enzyme kinetics - Michaelis - Menten equation.

TEXT BOOKS

1. Atkins P.W, “Physical Chemistry” ElBS, IV Edition
SEMESTER: I  CORE PAPER III

INTRODUCTION TO GRAPHICS

UNIT I  PROJECTION OF POINTS, LINES AND SURFACES

General principles of presentation of technical drawings as per BIS - Naming views as per BIS - First angle projection. Orthographic projection of points. Projections of straight lines located in first quadrant only - determination of true length and true inclination. Projections of plane surfaces like polygonal lamina and circular lamina, located in first quadrant only.

UNIT II  PROJECTION OF SOLIDS

Projection of simple solids like prism, pyramid, cylinder and cone - Drawing views when the axis of the solid is inclined to one reference plane.

UNIT III  SECTION OF SOLIDS AND DEVELOPMENT

Sectioning of simple solids like prisms, pyramids, cylinder, cone and sphere. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane. Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

UNIT IV  PICTORIAL PROJECTIONS

Isometric projection - Isometric scale - Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by vanishing point method.

UNIT V  COMPUTER GRAPHICS

Hardware display technology- Software introduction to CAD.

TEXT BOOKS

SEMESTER: I SKILL BASED SUBJECT I

BASIC WORK PRACTICE

1. SHEET METAL

   Tools and Equipments - Fabrication of tray, con e, etc., with sheet metal

2. WELDING

   Tools and Equipments - Arc Welding of butt joint, Tap Joint, Tee fillet etc., Demonstration of gas welding.

3. FITTING

   Tools and Equipments - Practice in Chipping, Filling, Drilling - making Vee joints, square and dove tail joints.

4. CARPENTRY

   Tools and Equipments- Planning Practice-making halving joint and dove tail joint models.

5. FOUNDRY

   Tools and Equipments Preparation of moulds of simple objects like flange, gear V-grooved pulley etc.,

6. SMITHY

   Tools and Equipments - Demonstration for making simple parts like keys, bolts etc.

REFERENCES:

SEMESTER: I  CORE PRACTICAL I

PHYSICS LAB

LIST OF EXPERIMENTS (ANY – 7 EXPERIMENTS)

1. Young’s modulus by non - uniform bending
2. Young’s Modulus – Uniform bending
3. Rigidity modulus and moment of inertia using Torsion Pendulum
4. Viscosity of a liquid by Poiseuille’s method
5. Determination of Refractive Index by I-D curve
6. Wavelength determination using grating by Spectrometer
7. Thermal conductivity by Lee’s disc.
8. Thickness of wire by Air wedge
9. Thermo e.m.f. measurement by potentiometer
10. Velocity sound in Air using Sona Meter
SEMESTER: II ALLIED PAPER II

MARINE MATHEMATICS-II

UNIT I  MULTIPLE INTEGRALS

Double integration in Cartesian and polar coordinates - Change of order of integration - Triple integration in Cartesian coordinates - Gamma and Beta functions.

UNIT II  ANALYTICAL FUNCTIONS


UNIT III  COMPLEX INTEGRATION

Cauchy’s theorem - Statement and application of Cauchy’s integral formulae - Taylor’s and Laurent’s expansions - Singularities - Classification - Residues - Cauchy’s residue theorem - Contour integration - Circular and Semi Circular contours (excluding poles on real axis)

UNIT IV  VECTOR CALCULUS

Gradient, Divergence, Curl - Line, surface & volume integrals - Statements of Green’s Gauss divergence and Stokes’ theorems - Verifications and applications,

UNIT V  STATISTICS

Moments - Coefficient of correlation - Lines of regression - Tests based on Normal and T distributions, for means and difference of means.

TEXT BOOKS
SEMESTER: II  CORE PAPER IV

PHYSICS-II

UNIT I  ENGINEERING MATERIALS


UNIT II  MECHANICAL PROPERTIES


UNIT III  CERAMICS & COMPOSITES


UNIT IV  SEMI CONDUCTORS


UNIT V  NON-DESTRUCTIVE TESTING


TEXT BOOKS

1. Arumugam M “ Engineering Physics, Anuradha Agencies
2. Arumugam M “ Material Science” Anuradha Agencies
SEMESTER: II  CORE PAPER V

MARINE CHEMISTRY-II

UNIT I ORGANIC REACTIONS AND THERMO CHEMISTRY

Organic reactions and mechanism - law of mass action - industrial enthalpy balances - free energies of metallic compounds - Ellingham diagram - metallurgical and multi component equilibrium - phase rule of metallurgical reactions - refractory materials.

UNIT II EXTRACTIVE METALLURGY AND ALLOYS

Ores - ore dressing - extraction processes - alloys - phase diagrams - heat treatment - non ferrous and special alloys - Powder metallurgy - Principles - compacting and sintering methods - applications.

UNIT III MARINE POLLUTION AND ENVIRONMENTAL PROTECTION


Chemical Toxicology: Bio-chemical effects of Lead, Mercury, Carbon monoxide, Nitrogen oxides, Sulphur dioxide, Ozone and Cyanide.

UNIT IV SURFACE PROTECTION


UNIT V CHEMISTRY OF EXPLOSIONS

Smoke bomb, rocket flares, rocket parachute and chemistry of pyrotechnics. Phase rule - definition - explanation of terms - examples - applications - one component and two component eutectic systems.

TEXT BOOKS

SEMESTER: II  CORE PAPER VI

BASIC MECHANICS

UNIT I STATICS OF PARTICLES

Coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - single equivalent force.

UNIT II EQUILIBRIUM OF RIGID BODIES

Free body diagram - Types of supports and their reactions - requirements of stable equilibrium - Equilibrium of Rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions.

UNIT III PROPERTIES OF SURFACES AND SOLIDS, FRICTION

Determination of areas and volumes - First moment of area and the centroid - second and product moments of plane area - parallel axis theorems and perpendicular axis theorems - polar moment of inertia - Principal moments of inertia of plane areas - Principal axes of inertia - Mass moment of inertia - relation to area moments of inertia.

Frictional force - Laws of Coulomb friction - simple contact friction - Rolling Resistance - Belt friction

UNIT IV DYNAMICS OF PARTICLES


UNIT V ELEMENTS OF RIGID BODY DYNAMICS

Translation and Rotation of Rigid bodies - Velocity and acceleration - General Plane motion moment of momentum equations - Rotation of rigid body - Work energy equation.

TEXT BOOKS

SEMESTER: II CORE PAPER VII

APPLIED ELECTRICAL AND ELECTRONICS

UNIT I A.C AND D.C. CIRCUITS & MACHINES


UNIT II TRANSFORMERS & INDUCTION MACHINES

Principle of operation of transformers - Types - Equivalent circuit - efficiency - testing - all day efficiency - principle of operation of three phase transformers - transformer connections. Construction of single phase motors - Types of single phase motors - Double revolving field theory - Starting methods - Capacitor start capacitor run motors - shaded pole - Repulsion - construction - Types - Equivalent circuit.

UNIT III ALTERNATOR & MEASUREMENTS

Principle of alternator - construction details - Types - Equation of induced EMF - Effect of power factor - Parallel operation - Torque equation - Synchronous condenser. Construction and principle of operation of moving coil and moving iron instruments (only voltmeters and ammeters) - dynamometer type wattmeter - Induction type energy meter.

UNIT IV SEMI CONDUCTORS AND TRANSISTORS

Bipolar junction transistor - CB, CE, CC - Configurations and characteristics - Biasing circuits - Elementary treatment of voltage amplifier - Class A,B and C power amplifiers - Field Effect Transistor - SCR, Diac, Triac. UJT - characteristics and simple applications - application in temperature and motor speed control.

UNIT V SIGNAL GENERATORS AND LINERARIC’S


DIGITAL ELECTRONICS: Binary number system - AND, OR, NOT, NAND, NOR circuits - Boolean algebra - Exclusive or gate - Half and full adders

TEXT BOOKS

1. B.L. Theraja, Electrical Technology- vol. I & II, S.Chand & Co
2. Edward Hughes, Electrical and Electronics Technology, Pearson Education Limited
SEMESTER: II SKILL BASED SUBJECT II
COMPUTER PRACTICE LAB

1. MULTIUSER OPERATING SYSTEM & FUNDAMENTALS OF COMPUTERS AND OPERATING SYSTEMS
   Unix: Introduction - basic commands - vi editor - filters - input/output redirection - piping - transfer of data between devices - shell scripts.

2. FUNDAMENTALS OF NETWORKING & OFFICE AUTOMATION
   Working on a network environment - accessing different machines from one node concept of E-mail - uses of internet.
   a) Word Processing
   b) Data Base Management System
   c) Spread Sheet Package
   d) Presentation Software

3. HIGH LEVEL LANGUAGE PROGRAMMING

TEXT BOOKS

SEMESTER: II CORE PRACTICAL II - MARINE CHEMISTRY LAB

1. Preparation of Normal Solutions.
2. Test for alkalinity & Total alkalinity.
3. Water treatment testing - Chloride Test.
4. Cooling water test:
   a. Nitrate Test
   b. Chloride Test
   c. PH Test.
5. Boiler water tests:
   a. Alkalinity Test
   b. Chloride Test.
   c. PH Test.
6. Lubrication Oil testing:
   a. Viscosity Test
   b. Water Content Test.
   c. Alkalinity Test
7. Fuel Testing:
   a. Determination of flash & fire points of liquid fuel.
8. Titrations:
   a. Determination of alkalinity of water sample.
   b. Determination of acidity of water sample.
   c. Determination of total, permanent & temporary hardness of water by EDTA method.
   d. Comparison of the strength of two acids.

TEXT BOOK:
SEMESTER: III  CORE PAPER VIII

BEHAVIOUR OF MATERIALS

UNIT I  STRESS


UNIT II BEAMS

Stresses in beams - neutral axis - theory of simple bending - bending stresses in rectangular, I-sections and circular section beams. Bending stresses in composite section beams. Shear stresses in beams - rectangular, I-sections and circular sections. Stress components on a general plane and oblique plane - Principal stresses and Principal Planes, Maximum shear stresses and their planes.

UNIT III SHEAR FORCE AND BENDING MOMENT

Bending moment - Shear force, BMD and SFD for statically determinate beams - cantilever - simply supports - over hanging beams - with or without applies moments, points of contra flexure. Statically indeterminate beams - BMD and SFD for fixed beams, propped cantilever beams and continuous beams - Theorem of three moments.

UNIT IV MOMENTS

Slope and deflection of Cantilever, overhanging and simply supported beams - Double integration method - Moment area method - problems with various types of load with or without applied moments and varying flexural rigidity (EI). Torsion of solid and hollow circular shafts - Power transmitted by shafts - compound shafts - shafts subjected to both twisting and bending moment - Open coil and closed coil helical springs.

UNIT V  COLUMNS AND STRUTS

Columns and struts - long and short columns - Euler’s formula for long column - equivalent length - slenderness ratio - Eccentric loaded long and short columns - Rankine Gordon formula., use of Strut Formulae. Thin cylinders and thin spherical shells - under internal pressure - change in volume due to internal pressure. Thick cylinders - simple treatment of thick cylindrical walled pressure vessels.

TEXT BOOKS:

SEMESTER: III CORE PAPER IX

MATERIAL SCIENCE AND METALLURGY

UNIT I  CRYSTAL STRUCTURES AND PHASE DIAGRAMS:
Simple cubic structure, BCC, FCC, HCP, Atomic packing factor, coordination number, Miller - Bravais space lattice system, single crystal, poly crystal, grain, allotropy and polymorphism, Bragg’s law, simple problems, defects in crystalline solid - vacancy, interstitial and impurity defects, edge and screw dislocation, low angle grain boundaries, grain size measurements.

UNIT II  DEFORMATION AND STRENGTHENING MECHANISM OF MATERIALS:
Deformation by slip, twinning, dislocation move - sources, elastic and elastic behavior, critically resolved shear stress, deformation in BCC, FCC and HCP materials, damping capacity and viscous deformation.
Strengthening from grain boundaries, solid solution stringing, fine particles, fiber, point defects, Martensic strengthening, yield point phenomenon - deformation hardening, annealing, preferred orientation and directional properties.

UNIT III  MECHANICAL; BEHAVIOUR AND TESTING OF MATERIALS:
Engineering and true stress - strain curves for different materials like mild steel, alloy steel, cast iron and rubber, proof stress, upper and lower yield stress, ductility measurements, different types of testing machines, compression test, various hardness tests and impact tests, codes and standards for different tests.

UNIT IV METALS ALLOYS AND MODERN MATERIALS:
Effects of alloying elements on properties of steel, carbon steel, low alloy steels, micro alloyed steel, stainless steels, tool steels and die steels, classification of cast iron, properties and their applications. Alloys of Al, Ti, Cu, Mg, Ni, Zn, and Pb - Properties and applications, bearing materials, brazing and soldering alloys. Shape memory alloy; inter metallic materials, functionally graded materials, composite and ceramic materials, properties and their applications.

UNIT V HEAT TREATMENT
Critical temperature on heating, annealing, spheroidizing, normalizing, hardening, isothermal transformation diagrams. CCT and TTT diagrams, martensic transformation, tempering, austempering and mar tempering, harden ability and its testing, simple problems, surface hardening processes, industrial application of different heat treatment processes.

TEXT BOOKS:
SEMESTER: III  CORE X

PRINCIPLES OF MANUFACTURING

UNIT I  METAL JOINING PROCESS

UNIT II  CASTING PROCESSES
Sand casting, Pattern and core making, moulding, moulding sand properties, gating and riser, moulding methods, melting furnaces - cupola, pit furnace and electric furnaces. Special casting processes - shell, investment, die casting - pressure and gravity types. Plastic moulding - injection and blow moulding, defects in casting and moulding - testing and inspection.

UNIT III  FINISHING PROCESSES

UNIT IV  METAL FORMING PROCESSES

UNIT V  MACHINING PROCESSES
Lathe: working principle, classification, specification accessories, lathe and tool holders, different operations on a lathe, methods of taper machining time and power required cutting, turret and capstan lathes.
Drilling and boring: machines - classification, specification, cutters speed feed, machining time parts and description of parts parts-boring machines - jig borer - description, types and whole location procedures.
Milling: classification, principle, parts - specification milling cutters indexing, selection of milling m/c fundamentals of inches processes, milling processes and operations.

TEXT BOOKS:
SEMESTER: III  CORE PAPER XI

BASIC THERMAL SCIENCE

UNIT I BASIC CONCEPTS OF THERMODYNAMICS:

Thermodynamics - systems, concepts of continuum, thermodynamic properties, equilibrium, processes, cycle, work, heat, temperature, Zeroth law of thermodynamics, First law of thermodynamics - applications to closed and open systems, internal energy, specific heats, enthalpy, steady and unsteady flow conditions.

UNIT II SECOND LAW OF THERMODYNAMICS AND ENTROPY

Statements, Reversibility, causes of irreversibility, Carnot cycle, reversed Carnot cycle, heat engines, refrigerators and heat pumps. Clausius inequality, entropy, principles of increase in entropy, Carnot theorem, available energy, availability.

UNIT III WORKING FLUIDS & GAS POWER CYCLES:

Thermodynamics properties of pure substances, property diagram, PVT surface of water and other substances, calculation of properties, first law and second law analysis using and other substances, calculation of properties, first law and second law analysis using tables and charts, Gas power cycles - Carnot, Otto, Diesel, Brayton, Ericsson, Sterling, Lenoir, Atkinson Cycles.

UNIT IV STEAM AND VAPOUR CYCLES


UNIT V STEAM NOZZLES & TURBINES:


TEXT BOOKS:

SEMESTER: III  CORE PAPER XII

MARINE ELECTRICAL SCIENCE - I

UNIT I  PRINCIPLES OF MEASUREMENT

Basic requirements of measuring instrument - Principles of indicating instruments - control and damping devices - Moving coil and moving iron instruments and their use of voltmeters and ammeters - Dynamometer type wattmeter - thermocouple type ammeter, voltmeters and wattmeter. Extension of instrument range.

UNIT II  PRINCIPLES OF D.C. MACHINES AND GENERATORS

Principles of DC Machines - construction - winding and e.m.f equations - Armature reaction - commutation - brush shift - compensating winding - D.C generator - their characteristics - methods of excitation - parallel operation - performance equations.

UNIT III  D.C. MOTOR


UNIT IV TRANSFORMERS

Transformers - Types and applications - operating principle - e.m.f equations - phase diagrams under no load and load conditions - leakage resistance - equivalent circuits - voltage regulation - losses and efficiency - open circuit and short circuit tests - parallel operation - three phase transformers - core and shell type - current and potential transformers - auto - transformers (single phase and three phase) - Effect of harmonics on transformers.

UNIT V  TRANSMISSION SYSTEMS


TEXT BOOKS:

SEMESTER: III  CORE PRACTICAL III

BEHAVIOUR OF MATERIALS LAB

1. Tensions Test on M.S. Rod.
2. Compression Test - Bricks, concrete cubes.
3. Deflection Test - Bench type verification of Maxwell theorem.
4. Tension test on thin wire.
5. Hardness test on various machines.
6. Tests on wood - Tension, compression, bending, impact in work testing machine.
7. Tests on springs - Tension, compression.

APPLIED MECHANICS LAB

1. Impact test.
2. Double shear Test in U.T.M.
3. Load measurement using load indicator, load coils.
4. Fatigue test.
5. Strain measurement using Rosette strain gauge.

SEMESTER: III  CORE PRACTICAL IV

ADVANCED WORK PRACTICE

WELDING TECHNIQUES:

1. WELDING- Exercises in Electric Arc Welding and Gas Welding Advanced Techniques.
2. HAND TOOLS- Hand tools, sharpening, powered hand tools, Measurements etc.,
3. SHEET METAL WORKING – Simple Exercise
4. PIPE WORK – Experiments involving thin pipes, joining, Bending, Welding and inspection.

LATHE AND SPECIAL M/C SHOP:

1. Lathe – Straight turning, Step Turning, Under Cut, Taper Turning, Knurling and Thread Cutting Exercises
2. Shaping Machine- Making Square from round rod and grooving exercises
3. Grinding- Exercise to the required accuracy on universal cylindrical Grinder and surface grinder.
4. Exercise on Milling machine
5. Slotting Machine: slotting and Key-Way Cutting
SEMESTER: IV  CORE PAPER XIII

MARINE PRIME MOVERS-I

UNIT I  PERFORMANCE CHARACTERISTICS OF IC ENGINES
4Stroke & 2-Stroke cycles; Deviation from ideal condition in actual engines, Limitation in parameters, Timing diagrams of 2-Stroke & 4-Stroke engines, comparative study of slow speed, medium speed & high speed diesel engines. Suitability & requirements for various purposes. Mean piston speed, MCR & CSR ratings. Practical heat balance diagrams & Thermal efficiency.

UNIT II  GENERAL DESCRIPTION OF MARINE DIESEL ENGINE
Constructional details of IC engines & Marine Diesel engines Components: Jackets & liners, Cylinder heads & fittings, pistons, cross heads, Connecting rods, crank shaft, bearings, Bed plates, A-frames, Welded construction for Bedplates & frames & Tie rods etc.

UNIT III SCAVENGING SYSTEM

UNIT IV FUELS
Liquid fuels - petroleum - Distillation process -effects of modern refining on residual fuel properties - fuel oil for marine diesel engines Testing & properties of fuel oils- Combustion of fuel- air for combustion -Combustion of hydro carbons Compression pressure ratio its effect on engines. Reasons for variation in compression pressure & peak pressure. Design aspects of combustion chamber. Control of NOx, SOx in Exhaust emission

UNIT V MARINE LUBRICATING OIL

TEXT BOOKS:
2. Wood Yard, Doug, “Pounder’s marine Diesel Engines” Butter Worth Heinemann
SEMESTER: IV  CORE PAPER XIV

FLUID SCIENCE

UNIT I FLUID STATIC
Properties of fluid- pressure head - Pascal’s law - absolute & gauge pressures measurement of pressure - manometers(single, U-tube, differential), Mechanical gauges Hydrostatic forces on a submerged plane and curved surfaces - centre of pressure Buoyancy and Floatation- Meta-centric height - stability of floating & submerged bodies

UNIT II FLUID KINEMATICS
Types of fluid flow-types of flow lines- rate of flow - continuity equation circulation & vorticity - stream function - velocity potential - equipotent line Cauchy Riemann equations - flow nets. FLUID DYNAMICS: Euler’s equation of motion-Bernoulli’s equation – applications Venturi meter, Orifice meter, Pitot tube - free liquid jet - impulse momentum equation Coriolis Co-efficient-flow through an orifice-Torricelli’s theorem-hydraulic coefficients.

UNIT III LAMINAR, TURBULENT FLOWS
Reynolds’s experiment - critical Reynolds number - Navier -Strokes equations of motion - relation between shear stress and pressure gradient - flow of viscous fluid in circular pipes- Hagen Poiseuille’s equation - turbulent flow - Darcy Weisbach equation major & minor energy losses-pipes in series & parallel-power transmission through pipes-boundary layer - characteristics - thickness - total drag due to laminar and turbulent layer-boundary layer separation & its control.

UNIT IV PUMPS
Rot dynamic pumps-principles of dimensional analysis-Buckingham’s [-] theorem-important dimensionless numbers applicable to fluid mechanics-centrifugal pumps some definitions - pump output & efficiencies - effect of vane angle - cavitations- constructional details, pump characteristics, multi stage pumps Axial flow pumps- characteristics- constructional details, non - dimensional parameters efficiencies. Vibration & noise in hydraulic pumps.

UNIT V HYDRAULIC TURBINES
Classification of hydraulic turbines - Peloton turbines, velocity triangle – efficiencies non dimensional numbers, working principle of the Peloton wheel. Francis & Kaplan turbines - velocity triangles- efficiencies of the draft tubes hydraulic turbine characteristics.

TEXT BOOKS:
SEMESTER: IV  CORE PAPER XV

MARINE ELECTRICAL SCIENCE - II

UNIT I ELECTRICAL MEASUREMENTS
Induction type energy meters-megger  Single phase and three phase wattmeter for power measurement, Measurement of energy, speed, frequency and phase difference Measurement of resistance, inductance and capacitance by bridge method Magnetic method, Location of cable faults Transducers and its application in the measurement of pressure Etc Simple electronic measuring devices CRO,IC tester, signal generator, Timers etc.

UNIT II ALTERNATORS
Alternators, General arrangement, Construction of salient pole and cylindrical rotor types Types of stator windings, e.m.f equation, Distribution and pitch factor Wave form of e.m.f generated, Rotating magnetic field, Armature reaction Voltage regulation, Load characteristics, open circuit and short circuit tests E.m.f and m.m.f methods, Parallel operation of alternators, KW and KVA Brushless alternator, Static excitation system.

UNIT III SYNCHRONOUS MOTORS
Principles of operation of 3-phase synchronous motor operation of infinite bus bars torque/angle characteristics Hunting, Methods of starting Merits and limits of synchronous motor over others.

UNIT IV INDUCTION MACHINES
Three phase induction motor Principles of operation and theory of action Slip speed, Rotor to stator relationship, Rotor frequency Rotor e.m.f and current, Torque/Slip characteristics Equivalent circuit relationship between rotor IR loss and rotor slip Starting torque and maximum running torque

UNIT V CONTROL OF INDUCTION MACHINES
Reversing, Speed control of induction motor, Starting of induction motor Method of starting, Direct on-line starters, star, delta starter Auto transformer starter, Starting of special high torque induction motors Single phase induction motor, Principles and operational characteristics Starting control, Constructional details, Failure & repairs of elect machines

TEXT BOOKS:
SEMESTER: IV  CORE PAPER XVI

PRINCIPLES OF MACHANISMS - I

UNIT I MECHANISMS
Introduction, Science of mechanism, Terms and definitions, Planar, Spherical and Spatial mechanisms, mobility classification of mechanisms (INDEXING, RECIPROCATING) Straight line generators, Kinematic inversion, Slider crank chain inversion, Four bar chain inversions, Grashoff’s law, Mechanical advantage, Determination of velocities and acceleration in mechanisms Relative motion method for mechanisms having turning, sliding and rolling pair, Coriolis acceleration, Analysis using vector mathematics for a four bar mechanisms, Analysis using complex numbers and loop closure equations for slider crank mechanism, inverted slider crank mechanism, four bar mechanism.

UNIT II SYNTHESIS OF MECHANISMS
Classification of kinematics synthesis problems, Thechebyeff spacing two points synthesis, Slider crank mechanism, Three positions synthesis, Four bar mechanism and slider crank mechanism, Freudenstein method Analytical and graphical design, Four bar linkage for body guidance Design of four bar linkage as a path generator.

UNIT III CAMS
Types of cams and followers, Followers motion, Uniform, parabolic, SHM, Cycloidal and polynomial, Synthesis of cam profiles for different followers Undercutting in cams, Planar, spherical and spatial mechanisms Pressure angle, Determination of minimum radius of curvature using design charts Vamun's Nomo gram, Cams of specified contour, Eccentric circle cam.

UNIT IV THEORY OF GEARING
Classification of gears, law of gearing, nomenclature, Involuties as a gear tooth profile, Layout of an involute gear, producing gear tooth Interference and undercutting, minimum number of teeth to avoid interference contact ratio, internal gears, Cycloid tooth profiles, Comparison of involutes and cycloidal tooth forms, non standard spur gears, Extended centre distance system, Long and short addendum system Epicyclical gear trains, Inversions of epicyclical gear trains

UNIT V CONTROL OF MECHANISMS
Governors, gravity controlled and spring controlled, Governor characteristics Governor effort and power, gyroscopes, Gyroscopic forces and couple forces on bearing due to gyroscopic action, Gyroscopic effects on the movement of air planes and ships

TEXT BOOKS:
2. Grover G.K- “Mechanical Vibrations” Nem Chand Bros, Roorkee
SEMESTER: IV  CORE PAPER XVII

APPLIED THERMAL SCIENCE – I

UNIT I  RECIPROCATING COMPRESSORS
Single stage Compressor-Ideal cycle for work transfer Mass flow, Volume flow, Free Air Delivery Effect of clearance and Volumetric Efficiency in single stage compressor Multi Stage compression neglecting clearance volume Condition for minimum work input and perfect inter cooling Tandem in line arrangements in compressors Air motors.

UNIT II BASIC REFRIGERATION & AIR CONDITIONING
Reversed Carnot Cycle- Vapour Compression Cycle Refrigerating Effect -Co efficient of Performance Cooling Capacity Refrigerants used in Marine application and their justification Rating of Refrigeration Plant Methods for improving COP Use of vapour tables -Applied Problems

UNIT III MARINE REFRIGERATING PLANTS
Typical Refrigerating plants with multiple compression & evaporation Heat pump cycles Refrigeration in liquefied gas carriers Applied problems

UNIT IV MARINE AIR CONDITIONING
Principles of air Conditioning Psychometric properties of air-Comfort conditions Control of humidity Air flow and A/C capacity Calculation for Ship plants

UNIT V BASIC PRINCIPLE OF HEAT TRANSFER

TEXT BOOKS:
1. Arora C.P “ Refrigiration & Air Conditioning” Sri Easwar Enterprise Chennai
SEMESTER: IV  CORE PAPER XVIII

ADVANCED GRAPHICS

UNIT I EXPLANATION AND SKETCHING OF THE FOLLOWING ASPECTS
Dimensioning conventions of shafts, arcs, angles, holes, tapers, welded joints, threads & pipes conventional representation of metals & materials. Sectioning conventions removed sections & revolved sections, parts not usually sectioned conventions of gears.

UNIT II LIMITS, FITS & TOLERANCES
Limits & tolerances, Surface finish, types of fits-description, Hole basis system and shaft basis system-calculations involving minimum & maximum clearances for given combination of tolerance grades-Simple problems, geometric tolerances.

UNIT III SPRINGS
Design of helical, leaf and torsional springs under constant & varying loads.

UNIT IV MACHINERY COMPONENT DRAWING
Drawing of complete machine components in assembly (Orthographic to Isometric and Isometric to Orthographic) with details like couplings, glands, return & non- return valves Cocks & plugs, cylinder, Boiler mountings - Full bore safety valve, Blow down cock, Gauge glass, Main stop valve.

UNIT V MARINE COMPONENT DRAWING
Assembly drawings of simple marine components in orthographic projection from Isometric view e.g. Bilge Strainer boxes, control valves, Cylinder relief valves, Boiler blow down cock.

TEXT BOOKS:
1. N.D.BHATT “ Machine Drawing” Charotar Publications Mumbai
SEMESTER: IV CORE PRACTICAL V
FLUID SCIENCE LAB

(A) FLUIDS LAB
Buoyancy Experiment – Metacentric Height for Cargo and War ship models.
Fluid flow measurement using Pitot tube, Flow nozzle, Rotometer, Notches etc.
Cd of Venturimeter and orifice-meter.
Determination of frictional losses in pipes.

(B) FLUIDS APPLICATION LAB
Centrifugal pumps – Performance characteristics of a constant speed pump, specific speed.
Performance characteristics of multistage pump.
Positive displacement pumps.
Performance characteristics of a deep well pump.

SEMESTER: IV CORE PRACTICAL VI
THERMAL SCIENCE LAB

THERMAL SCIENCE LAB
Flue gas analysis by Orsat apparatus.
Test on Reciprocating compressor.
C.O.P of a Refrigeration plant.
Testing of fuels – calorific value, proximate analysis
Testing of fuels – Ultimate analysis, octane number, cetane number.
Testing of lubricants – flash point, fire point, pour point.
Testing of lubricants – Mechanical stability, ash content.
Performance test on IC Engine as per BIS specifications.

BOILER CHEMISTRY LABORATORY
To determine hardness content of the sample of oiler water in P.P.M in terms of Caco3.
To determine Chloride Content of the sample of water in P.P.M in terms of Caco3.
To determine Alkalinity due to Phenolphthaleine, total Alk. And caustic Alk. Of the sample of water (in P.P.M)
To determine Phosphate Content of the sample of water.
To determine dissolve Oxygen content of the sample of water.
To determine sulphate content of given sample of water.
To determine Ph-value of the given sample of water.
Boiler trial.
Water Testing – Dissolved oxygen, total-dissolved solids, turbidity.
Water Analysis (Fresh and sea water) – Chloride, sulphate, hardness.
Sludges and scale deposit – Silica, volatile and non volatile suspended matter.
SEMESTER: V  CORE PAPER XIX
MARINE AUXILIARY DEVICES - I

UNIT I ENGINE ROOM
Layout of main and auxiliary machinery in Engine Rooms in difference ships.

**Engine Room Piping Arrangements & Fittings:** Steam and condensate system, water hammering in pipes, Expansion joints in pipelines, Bilge - ballast, fuel oil bunkering and transfer system, bunkering procedure, precautions taken, fuel oil service system to main and auxiliary engines, lubricating oil and Engine cooling system to main and auxiliary engines, central cooling and central priming systems, control and service air system, domestic fresh water and sea water (Hydrophore) service system, drinking water system, fire main system.

UNIT II VALVES
**Valves and cocks:** Straight way cocks, right angled cock, ‘T’ cock, spherical cock, Boiler gauge glass cock (cylindrical cock). **Valves:** Globe valves, SDNR valve, swing check valve 9Storm valve) gate valves, butterfly valves, relief valves, quick closing valves, pressure reducing valves, control valves, change over valve chests, fuel oil transfer chest, valve actuators, steam traps.

**Jointing:** Pickings, Insulation of materials, Types - Various applications. Seals - purpose of bearing seal, description and application of non rubbing seals and rubbing seals, simple felt seal, seals suitable for various peripheral speeds, V - ring seals, Lip seals.

**Filters and strainers:** Filtration, filter elements basket strainers, duplex strainers, edge type strainers, auto - kleen strainers, back flushing strainers, magnetic filter, rotary filters fine filters.

UNIT III PUMPS
Types of pumps for various requirements - their characteristics, performance and application in ships - centrifugal pumps - gear pumps - screw pumps and reciprocating pumps - care and maintenance of pumps.

UNIT IV HEAT EXCHANGERS, EVAPORATORS AND DISTILLERS
Principle of surface heat transfer description, contact heat transfer, construction of shell and tube type - flat plate type single and double pass - lubricating oil coolers, fuel - oil heaters, fresh water coolers compressed air coolers, Main Engine charge air cooler, Fresh water heaters, steam condensers, evaporators and condensers in refrigeration system - materials used in all the above heat exchangers, expansion allowance - temperature controls effect of air in the system - maintenance.

Distillation of water, distilling equipment, problem of scale formation and method of controlling, methods of distillation, single effect and double effect shell type evaporator, low pressure vacuum type evaporator, flash evaporators, salt water leaks and detection, reverse osmosis desalination plant, membranes, drinking water a d treatment.

UNIT V STEERING SYSTEM:
Hydraulic Telemotor system (Transmitter and receiver), Bypass valve 0 charging system, - hydraulic power unit 0 hunting gear heleshaw pump principle, construction and operation - pawl and ratchet mechanism, 2 - ram and 4 - ram steering gear - All -electric steering gear, principle
and operation - Hunting gear and emergency steering gear. Electro-hydraulic steering gear, Raphson and slide Actuators, Rotary vane steering gear - principle - construction - operation - safety features, relief, isolating and bypass valves, steering system regulations and testing - trouble shooting - rectification maintenance. Navigational safety of a ship - case history, cause and/or errors - how to avoid rudder restraining, general requirements - requirements for large tankers and gas carrier, additional requirements (electrical) definitions - controls - automatic system, general arrangement - rudder and pintle, rudder wear down - rudder carrier.

Text Books:

SEMESTER: V CORE PAPER XX
MARINE ELECTRONICS

UNIT I

UNIT II

ITAL & CMOS GATES: Digital integrated circuits- Semi conductor memories - ROM -RAM and PROM.

UNIT III
Converters ;(A-D and D-A): Analog to Digital and Digital to Analog Converters and their use in Data- Loggers.


UNIT IV
Industrial Electronics: Power rectification - silicon control rectifier power control - Photoelectric devices - invertors. Satellite communication as applicable to GMDSS.

UNIT V
MICROPROCESSORS: 8085 Architecture- Programming - interfacing and control of motors - Temperature/ Speed control.

TEXT BOOKS:
SEMESTER: V  CORE PAPER XXI

NAVAL ARCHITECTURE - I

UNIT I HYDROSTATICS

Pressure exerted by a liquid, load on an immersed place, center of pressure, load, diagram, shearing force on bulkhead stiffeners, Archimedes’ principle, displacement, T.P.C. immersion, coefficients of form, wetted surface area, similar figures, shearing force and bending moment - problems.

UNIT II GEOMETRY AND SHIP FORM CALCULATIONS

Ship lines, first and second moment of area, Simpson’s first and second rules, application to area and volume, use of intermediate ordinates, trapezoidal rule, mean and mid - ordinate rule, Tchebycheff’s rule and their applications, centre of gravity, effect of addition and removal of masses, effect of movement of mass and suspended masses - Problems

UNIT III TRANSVERSE STABILITY AND HEEL

Statistical stability at small angles of heel, calculation of BM and Metacentric height, inclining experiment, free surface effect, stability at large angles of heel, curves of static stability, dynamic stability, angle of loss, stability of wall sided ship - Problems

UNIT IV LONGITUDINAL STABILITY AND TRIM

Longitudinal BM, MCTI cm, change of trim, change of LCB with change of trim, alteration of trim due to adding or deducting weights, change in mean draught and end draughts due to density and due to bilging, flooding calculations, floodable lengths, factors, of sub division, loss of stability due to grounding - Problems

UNIT V LAUNCHING AND DOCKING

Launching curves, construction of launching curves, ground ways, the dynamics of launching, strength and stability, sideways launching. Docking - Docking stability, pressure on chocks, load distribution, block behavior, strength of floating docks, stability during docking, ship lifts - Problems

Text Books:

SEMMESTER: V ELECTIVE I

UNIT I SHIP TERMS

SHIP CONSTRUCTION

Various terms used in ship construction with reference to ship’s parameter e.g. L.B.P.-Moulded Depth - Moulded draught etc. - General classification of ships. Stresses in Ship’s structure: Hogging - Sagging - Racking - Pounding - Panting etc., and Strength members to counteract the same. Sections and materials use: Type of sections like angles - Bulb plates flanged beams used in ship construction - Riveting & Welding testing of welds - Fabricated components.

UNIT II BOTTOM & SIDE FRAMING


UNIT III FORE & AFT END ARRANGEMENT

Fore end arrangement,. Arrangements to resist pounding bulbous bow - Types of sterns stern frame and rudder - Types of rudder - Supporting of rudder - Locking pintile - Pallister bearing shaft tunnel - Tunnel bearings,

UNIT IV FREE BOARD AND TONNAGE


UNIT V OFFSHORE TECHNOLOGY

Drilling ships and Platforms - Supply vessels - fire fighting arrangement - Pipe laying ships - special; auxiliary service ships. Ship Surveys: Survey rules - Functions of ship classification - Societies - Surveys during construction - Periodical surveys for retention of class.

Text Books:

SEMESTER: V CORE PAPER XXII

PRINCIPLES OF MACHANISMS-II

UNIT I FORCE ANALYSIS OF MACHANISMS:
Static, Inertia and combined force analysis - graphical and analytical method - slider crank mechanism and four bar mechanism, turning moment diagram and flywheel - applications in engine, punching presses.

UNIT II BALANCING
Static and dynamic balancing - balancing of rotating masses - balancing of several masses in different planes - balancing of rotors, balancing machine, unbalance due to reciprocating parts - balancing of inline engines - firing order - balancing of V and W engines - Balancing of radial engines - Lanchester techniques of engine balancing.

UNIT III FREE VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS:
Periodic motion - non harmonic periodic motion - Fourier analysis – un damped free vibration - linear and torsion solution - natural frequency of single degree freedom system - Bifilar, Trifler suspensions - Free vibrations with viscous damping of single degree freedom system and solution - logarithmic decrement.

UNIT IV FORCED VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS
Forced vibration of single degree freedom system with damping - reciprocating and rotating unbalance - vibration isolation and transmissibility - base excitation - self excited vibrations with examples.

UNIT V TWO AND MULTI DEGREE FREEDOM SYSTEMS
System with two degrees of freedom - shaft with two rotors, vehicle suspension - vibration absorber - torsion vibration dampers, system with many degrees of freedom - Holzer’s analysis of free torsion vibrations with multi rotor systems - three rotor system - geared system - method of influence coefficients, continuous system - axial vibration of bars, lateral vibration of cantilevers, simply supported beams - Rayleigh’s method, torsion vibrations of shafts, Dunkerley’s method for lateral and torsion vibration problem.

Text Books:
SEMESTER: V  CORE PAPER XXIII

MARINE DESIGN AND DRAWING

UNIT I

Engineering Design: The design process, concepts, analysis, feasibility, Functional design, production designs. Selection of materials and manufacturing considerations in design. Economics, aesthetic appeal, initial and recurring costs, plans, drawings and manuals. Design with reference to repairs and reconditioning, specifically for working out at sea with its restrictions and limitations.

UNIT II

Types of Loading and Design Criteria: Strength, rigidity and deflection of machine elements stresses due to static loads, impact, loads, repeated loads, variable and cyclic loads, combined and reversible loads. Stress concentration and design factors, fatigue strength, modes of failure, design stresses, factor of safety, theories of failure, wear, corrosion, design criteria, S-N curve Goodman and Soderberg equations.

UNIT III


UNIT IV

Power Transmission Elements: Shafting with bending, twisting and axial loading based on strength and rigidity, rigid and flexible couplings. Belt drives & hoists (Wire ropes).

UNIT V

Friction clutches and Brakes: Multiple place clutches, cone clutch, centrifugal clutch block brakes, internally expanding shoe brakes, external band brakes, differential band brakes.

Text Books:
SEMESTER: V  SKILL BASED SUBJECT III
ELECTRICAL, ELECTRONICS AND MICRO PROCESSOR LAB

ELECTRICAL ENGINEERING LABORATORY
Load Test on D.C Shunt Motor.
Load Test on D.C. Series Motor.
O.C.C & Load characteristic of self / separately excited D.C. Generator.
Parallel operation of D.C Shunt Generator.
Speed con troll of D.C. Shunt Motor.
Load O.C. & S.C. test on single - phase transformer
Parallel operation of single - phase transformers.
Synchronization of 3 - phase alternator.
Trouble shooting in Electric Motor and Transformers.
Exercises in Power Wiring and earthing

ELECTRONICS LABORATORY
To study the colt - ampere characteristics of a high current semi conductor diode.
To study the colt - ampere characteristics of a diode and Zener diode.
To study the half wave and full wave rectification circuit without and with filter circuit.
Transistor Designer test
Semiconductor devices characteristics test
Digital & Liner Trainer
Arithmetic operations using 8085
Logical Operations using 8085
Array Operations 8085
Speed and Direction control of Stepper motor using 8085

SEMESTER: V  SKILL BASED SUBJECT IV
MEASUREMENT & INSTRUMENTATION LAB

MEASUREMENTS LABORATORY
Use of precision measuring instruments like micrometer, vernier, height and depth gauges,
surface plate, etc.
Checking dimensions of a part using slip gauge.
Use of sine bar for measuring angles and tapers.
Measurement of tooth thickness by gear tooth vernier
Calibration of dial gauge.
Taper and bore measurement - using spheres.
Testing squareness of a try square using slip gauges.

INSTRUMENTATION LABORATORY
Pressure measuring devices -pressure and vacuum gauge calibration. Temperature measuring
devices like Platinum resistance thermometer, thermocouple, radiation pyrometer, etc,
Flow measuring devices like orifice meter, roto meter, etc.
SEMESTER: VI  CORE PAPER XXVI

MARINE PRIME MOVERS-II

UNIT I FUEL PUMPS AND METERING DEVICES


UNIT II MANOEUVRINGS SYSTEMS

Starting and reversing systems of different Marine diesel engines with safety provisions Indicator diagrams and Power Calculations. Constructional details of indicator instrument, significance of Diagram, power calculations, fault detection, sample draw cards and out of phase-diagrams, Power balancing, performance characteristics curves, test bed and sea trials of diesel engines.

UNIT III MEDIUM SPEED ENGINES

Different types of medium speed marine diesel engines, couplings and reduction gear used in conjunction with medium speed engine, development in exhaust valve design, V-type engine details.

UNIT IV FORCES AND STRESSES

Balancing, overloading, different types of vibration & its effects, forces And stresses acting on various components of I.C Engine parts

UNIT V DIESEL ENGINES

Construction and operation of Sulzer, B&W, MAN, Piel-stick, Doxford, Marine Main diesel engines, latest development in marine diesel engines- Sulzer RTA, B&W CMC & SMC, SEMT Piel-stick, etc cam less concept, improvement in design for increased TBO UMS operation of ships.

TEXT BOOKS:

2. Wood Yard, Doug, “Pounder’s marine Diesel Engines” Butter Worth Heinemann
SEMESTER: VI  CORE PAPER XXVII

NAVAL ARCHITECTURE-II

UNIT I RESISTANCE

Types of resistance, frictional, residuary, and total resistance, air, appendage, wave making
Eddy and form resistances, model testing, propeller tests in open water admiralty coefficient, fuel
coefficient and consumption, sea trials - problems.

UNIT II PROPELLERS

Types of propellers, apparent and real slip, wake, thrust, relation between powers, relation
between mean pressure and speed, measurement of pitch, cavitation built and solid propellers,
interaction between the ship and propeller, hull efficiency overall propulsive efficiency -
Problems.

UNIT III RUDDER THEORY

Types of rudders, model experiments and turning trials, area and shape of rudder, position of
rudder, stern rudders vs. bow rudders, forces on rudder, torque on stock angle of heel due to
force on rudder, angle of heel when turning problems.

UNIT IV MOTION OF SHIP ON WAVES

Theory of waves, trochoidal waves, relationship between line of orbit centres and the undisturbed
surface, sinusoidal wave, irregular wave pattern, wave spectra were amplitudes, rolling forces
caused by rolling, pitching, heaving and yawing.

UNIT V SHIP DESIGN

Design requirements, influence of nature of cargo on ship type, determination of principle
dimensions, calculation of steel and outfit masses, the ship form, stability and trim, determination
of scantlings of the structure, general arrangement cost, design optimization.

TEXT BOOKS:

SEMESTER: VI  CORE PAPER XXVIII  -  MARINE ELECTRICAL SCIENCE

UNIT I MARINE ENVIRONMENT
The marine environment, Effects of inclination, Generators, Power supply commonly available, Main switchboard, Motor control, Emergency services ,Emergency stop panel, Ships auxiliary services, Load analysis, Electrical diagrams, Inherent dangers & avoidance of Inherent dangers and avoidance of disastrous consequences, Active and passive safety measures, Do's and Don'ts, Electric shock, First aid, Conditions of shock risk, Selection of AC and DC generators for use on ships, Merits and demerits Locations and Installation of generators sets, Requirements & Regulations, Safe electrical equipments for Hazardous areas, American safety standards, Common definitions, British and European standards Tanker installation ,Installations Ashore, Indian standards , Systems of AC distribution , General Distribution scheme ,Specific systems for 2,3 and wires Tankers schemes, Primary power bus , Need for emergency power supply, Method of supply-Passengers and cargo vessels requirements, Shore supply, Precautions to be taken while consuming shore supply, Arrangement to ensure proper phase supply, Remote switches to ventilating fans, Fuel pumps, Lubricating oil pumps and purifiers.

UNIT II INSTRUMENTATION AND SWITCHGEAR
Insulated & Earthed neutral systems, introduction, circuit faults, causes, prevention earth fault indicators, detection and clearance, alternators. AVR : excitation systems carbon pile regulator, vibrating contact and static automatic, regulator, transient voltage dip and alternator response, effect of kW and kVAR loading. Panel Instrumentation: introduction, system terminology, phase sequence indicators-parallelining of alternators: manual and auto Synchronizing, lamps, parallel operation excitation and throttle control, load sharing, kW, kVAR and manual. Switch boards & Switchgear: main and sub switchboard, rating and characteristics of main switchboards, groups starter boards, distribution fuse boards, bus bars instrumentation & controls, circuits breakers, alternator CB's, MCCB's miniature CB's, RCCB's are fault current interrupts, fused isolators, fault protection devices Introduction, over voltage, surge, transients, ripple, spikes, DC generator protection alternator and system protection, protection through fuses, protection discrimination motor protection.

UNIT III CABLES AND LIGHTING SYSTEMS
UNIT IV PROPULSION AND STEERING SYSTEMS

Propulsion systems: Auxiliary propulsion systems-Layout & optimizing storage space- Electrical Propulsion-Advantages & disadvantages. DC constant current systems-DC motor supplied from alternators-Turbo electrical propulsion- AC single speed and Induction motor drives-Fixed speed alternators- Cyclo converter device- Diesel electric propulsion-Thruster & water jet propulsion steering systems & Gyrocompasses: Fundamentals- Auto Navy steering systems- Type P-Electro hydraulic steering-Control systems-Typical system configuration-Components-Auto steer types


UNIT V AUXILIARIES AND MAINTENANCE


TEXT BOOKS:

1. Bowic C.T “Marine Electrical practice” Butter worthy London
2. Law S.W “Electricity applied to Marine Engineering”
SEMESTER: VI  CORE PAPER XXIX
MARINE MACHINARY SYSTEM DESIGN

UNIT I SLIDING CONTACT BEARINGS
Journal bearings, thrust bearings, friction in journal bearings, bearing loads, bearing design using various equations. Thermal equilibrium Rolling Contact bearings: load ratings, types of radial ball bearings, selection of bearings, lubrication of ball & roller bearings, methods of failure.

UNIT II SPUR AND HELICAL GEARS
Basic design principles of spur gears, helical gears, dynamic tooth loads Design for strength and wear, Lewis and Buckingham equation. BEVEL AND WORM GEARS Basic design principles of bevel gears and worm gears, lewis formula Thermal rating of worm gears.

UNIT III DESIGN OF IC ENGINE PARTS
Piston, connecting rod with bearings, crankshaft, flywheel and rocker arms

UNIT IV DESIGN OF COMPONENTS
Safety valve and reducing valves Crane hooks, lifting chains, Engine room E.O.T Crane

UNIT V  DESIGN CRITERIA OF MARINE SYSTEM
Water cooling systems for diesel engines & steam plants, Lubricating oil systems for propulsion& auxiliary engines. Electro hydraulic steering gear system including rudder, rudderstock, tiller, rams. Marine diesel engine air starting system including air receiver, compressor& air starting valves. Marine diesel engine scavenge & exhaust systems. Marine diesel engines fuel injection system including fuel pumps & fuel injectors. Power transmission system including thrust blocks, intermediate shaft, steam turbine plants, and gas turbine plants

TEXT BOOKS:
SEMESTER: VI  CORE PAPER XXX

MARINE AUXILIARY DEVICES -II

UNIT I POLLUTION PREVENTION
Oily water separators their construction and operation, use of coalescers, prevention of oil pollution
Various international requirements, (MARPOL ACT), other shipboard equipments: incinerators.
Sewage treatment plant, principle of operation, construction, maintenance, and fault finding
analysis.

UNIT II DECK MACHINERY
Various types of deck machinery used in ships e.g.-deck cranes winches &windless their
requirements, Operation and maintenance. Hatch covers-different types of stabilizers- bow
thrusters. Oil purification: Theory of oil purification, Principles of operation &construction of
centrifuges for heavy oils. Blowers & Compressors: operational and constructional details of
blowers and compressors used on board ships.

UNIT III SHAFTING
Methods of shaft alignment, constructional details and working of thrust block. Intermediate shaft
bearing Stern tube bearing. Oil and water lubricated stern tubes. Sealing glands. Stresses in tail end
shaft, Intermediate shaft & thrust shaft.

UNIT IV DRYDOCKING
Methods of dry-docking of ships, inspection and routine overhauling of underwater fitting and hull,
Measurement of clearances and drops, removal & fitting of propellers and rubbers, Main and stern
tubes, inspection and maintenance.

UNIT V NOISE & VIBRATION
Elements of aerodynamics and hydrodynamics sound, noise sources on ships and noise
suppressions techniques, noise level measurement, various modes of vibration in a ship (i.e. free
forced, transverse, axial, torsion, their sources and effects). Resonance and critical speed, structure
borne and air borne, vibration, anti vibration mountings of machineries, de tuners dampers with
reference to torsion vibrations dampers, use of Torsion graphs

TEXT BOOKS:
SEMESTER: VI  CORE PAPER XXXI

SHIP’S ADVANCED FIRE PREVENTION AND CONTROL

UNIT I FIRE PROTECTION BUILT IN THE SHIPS
SOLAS Convention, requirements in respects of materials of construction and design of ships
Fire detection and extinction systems, fire test, escape means, electrical installation-ventilation
system & venting system for tankers statutory requirements for firefighting systems and
equipments on different vessels, fire doors & fire zones.

UNIT II DETECTION AND SAFETY SYSTEMS
Fire safety precautions on cargo ships, tankers and passengers ships during working. Types of
detectors, selection of fire detectors and alarm systems and their operational limits.
Commissioning and periodic testing of sensors and detection systems. Description of various
fitted on ships

UNIT III FIRE FIGHTING EQUIPMENT
Fire pumps, hydrants and hoses, couplings, nozzles and international shore connection,
construction, operation and merits of different types of portable, non-portable and fixed fire
extinguisher installations for ships, properties of chemicals used, water-mist fire suppression
system-advantages of various fire extinguishing agents including vaporizing -fluids and their
suitability for ship's use. Control of class A, B, C & class-D fires, combustion products & their
effects on life safety.

UNIT IV FIRE CONTROL
Action require and practical techniques adopted for extinguishing fires in accommodation,
machinery spaces, boiler rooms, cargo holds gallery etc. fire fighting in port and dry dock.
Procedure for re-entry after putting off fire, rescue operations from affected compartments. First
aid, fire organization on ships, shipboard organization for fire and emergencies. combustion
products and their effects on life safety, fire signal and muster fire drill. Leadership and duties,
fire control plan, human behavior.

UNIT V SPECIAL SAFETY MEASURES
Special safety measures for preventing, fighting fire in tankers, chemical carriers oil rings,
supply vessels, and fire fighting ships, safe working practice with respect to fire on board ships
and first aid for hazards arising from fire in ships.

TEXT BOOKS:
1. “Fire Abroad” by Frank Rush Brook- Son & Ferguson Ltd.
2. “Reed’s Ship Construction for Marine Students” Vol.5- Thomas Reed Publication
SEMESTER: VI ELECTIVE II
PRINCIPLES OF MANAGEMENT

UNIT I Management, Ethics & Planning
Definition of management; Its nature and purpose- Managing : Science or art – Elements of science- Patterns of managements analysis-Systems approach to operational management-Functions of managers-- Social responsibility of managers- Ethics in managing- Types of plans- steps in planning- The planning process: A Rational approaches to goal achievements.

UNIT II Objectives, Strategies, Decision making in Management.
Nature and concept of management objectives – How to set objectives – Benefits and weakness of management by objectives and some recommendations- Major kinds of strategies and policies- Effective implementation of strategies- Importance and limitations of rational decision making- Rationality in decision making- Evaluation of alternatives- Evaluating the importance of a decision.

UNIT III Organizing, Departmentation, Authorities in a Firm.
Formal and informal organization- organizational division; the department-Organizations levels and the spans of management – The structure and process of organizing- Departmentation by time and enterprise function – Departmentation by territory-Customer departmentation- Departmentation by product- Choosing the pattern of departmentation- Authority and power-Line and staff concepts-Functional authority- benefits and limitations of staffs- Decentralization of authority.

UNIT IV Organization Culture & HRM Process.
Avoiding mistakes in organizing by planning- Avoiding Organizational inflexibility- Making staff work effective-Avoiding conflict by clarification- Ensuring understanding of organizing- Promotion an appropriate organization culture- Systems approach to human resources- Management : An overview of the staffing function- Selection: Matching the person with the job- Position requirements and job design- Skills and Personal characteristics needed by managers- Selection process, Techniques and instruments.

UNIT V Performance Appraisal, carrier strategy, Motivation, Leadership in Management.
Purpose of a performance appraisal- Problem of management appraisal-Choosing the appraisal criteria – Traditional trait appraisals- Formulating the carrier strategy-Motivation and motivators- Hierarchy of needs theory- Motivation-Hygiene approaches to motivation- A systems and the Contingency approach to motivation- Defining Leadership-Ingredients of leadership-Trait approaches to leadership- Leadership behavior and styles- Situational or Contingency approaches to leadership.

TEXTBOOKS:
SEMESTER: VII  CORE PAPER XXXII

SHIP OPERATION MANAGEMENT AND IMO REQUIREMENTS

UNIT I STRUCTURE OF A SHIPPING COMPANY
Principal shipping organization, various types of marine vessels & cargo Classification, ownership of vessels, registration of ships, flags of convenience IMO identification number, structure of a shipping company, functions Departments, financing, economics of new and second hand tonnage subsidies.

UNIT II COMMERCIAL SHIPPING PRACTICE
Planning sailing schedules and voyage estimates, linear and tramp shipping services Conference systems, chartering and charter parties, Ship papers for arrival and departure, port procedures, role of agent, theory of agents Theory of freight rates, bill of lading, pilotage, cargo surveys, note of protests Carriage of goods by sea act.

UNIT III MARINE INSURANCE
Underwriting and loss adjusting principles applied to marine cargo insurance Hull/machinery policy, particulars average, general average, P & I Clubs.

UNIT IV IMO
IMO Conventions, legislation, MARPOL acts and conventions annexes I TO IV SOLAS 1974 & amendment, Main objectives, overview of all chapters &articles OPA 90, Ballast Water Management.

UNIT V STCW
International convention on STCW for seafarers 1978 with 1995 amendments Overview of all sections, manning of ships, engagement and discharge of ship crew Ship articles, merchant shipping act, port state control PSC Mandatory certificate check list, grounds for PSC inspection criteria for detention.

TEXTBOOKS:

1. B.F.Stevens & C.S.J.Butterfield” Shipping Practice” – Sterling Book House Mumbai
SEMESTER: VII  CORE PAPER XXXIII

APPLIED THERMAL SCIENCE - II

UNIT I VARIOUS TYPES MARINE BOILERS & BOILER MOUNTINGS
Scotch Boiler, Cochran, spanner, Clarkson thimble tube Waste heat recovery scotch boiler, Composite boilers, water tube boilers Babcock Wilcox, foster wheeler-D-type, Double evaporation boilers Boiler mountings: safety valves, improved high lift, full lift bore type, gauge glass Ordinary plate type and remote indicator, automatic feed regulator Three elements high & low level alarms, Main stream stop valve Retractable type soot blower etc.,

UNIT II OPERATION, CARE & MAINTENANCE OF BOILERS
Pre-Commissioning procedures, Hydraulic tests, steam raising & operation proc Action in the event of shortage of water, blowing down of boiler, laying up a boiler General maintenance, external and internal tube cleaning, tube renewals etc Inspection and survey of boilers Refractory: Purposes of refractory, types of refractory and reasons for failure Oil burning: Procedure of liquid fuel burning in open furnace Various types of atomizer, furnace arrangement for oil burning, boiler control system Fuel control, air control and viscosity control, introduction to automation.

UNIT III MARINE STEAM ENGINEERING
Reciprocating/steam engines: History of multiple expansion marine reciprocating engines & steam turbines Description of different types of steam turbines Layout of plant: General layout of plant & description of a modern geared steam turbine open and closed feed system Selection of materials: Materials used in various components like blades, rotors Casings, sealing glands, gears etc & their justification.

UNIT IV LUBRICATION OF TURBINES
Suitable oils and their properties, lubrication of main bearings, Thrust bearings and gears, gravity and pressure lubrication oil system

UNIT V CONDENSERS
Condensers: Types of condensers, constructional details, location Working principles, contraction and expansion allowances, leak test Effect of change of temperature, circulating water quantity engine power Operation & management: Turbine drain system, turbine gland system Warming through a turbine plant, control of speed and power of propulsion Through a turbine plant, control of speed and power of propulsion Throttle valve control and nozzle control, emergency controls.

TEXTBOOKS:

2. C. McBirnie, “Marine Steam Engines and Turbines”
SEMESTER: VII  CORE PAPER XXXIV

MARINE CONTROL AND AUTOMATION

UNIT I CONTROL SYSTEM
Introduction to control terms, block diagrams for control systems, Open loop and closed feedback control, comparison of closed loop Feed forward control, feed forward modification Regulators and servomechanism, proportional plus integral plus derivative Use of various control modes.

UNIT II GRAPHICAL REPRESENTATION OF SIGNALS
Inputs of step, Ramp sinusoid, pulse and impulse, Exponential function etc The dynamics of a simple servomechanism for angular position control The torque proportional to error, servo mechanism Technique for improving the general performance of servomechanism The frequency response test, series compensation using Nyquist diagram.

UNIT III PROCESS CONTROL SYSTEMS
Automatic closed loop process control system dynamic characteristics Dynamic characteristics of controller Electronic instrumentation for measurements and control analogue Basic concepts, analog computers, stimulation, uses, hybrid computers.

UNIT IV TRANSMISSION
Pneumatic and electric transmission, suitability for marine use Pneumatic and types of controller’s hydraulic, electric and electronic controllers correcting units: diaphragm actuators, valve petitioners, piston actuators Electro pneumatic transducers, electro hydraulic and electric actuator control.

UNIT V APPLICATION OF CONTROLS ON SHIPS
Marine boiler, automatic combustion control, Air fuel ratio control, Feed water control single 2 & 3elements type, steam pressure control Combustion chamber pressure control, fuel oil temperature control Jacket cooling water, fuel valve cooling water, piston cooling, scavenge air Fuel oil viscosity control of main machinery, Instruments for UMS Classification.

TEXTBOOKS:
2. Leslie Jackson “Instrumentaion and Control Systems” Thopmas Reed publication Ltd.
SEMESTER: VI  CORE PAPER XXXV

SAFE WATCH KEEPING AND CLASS IV PREPARATION

UNIT I SAFE WATCH KEEPING
Definition of watch, operating principles, requirements of watch keeping Requirements of certification, duties of engineer officers Operation of engine room in general, log book writing Watch keeping at port, at unsheltered anchorage, fitness duty Preparation of diesel engines for a long voyage, bad weather precaution Safe working practices, during overhauling at port Change over from diesel oil to heavy oil vice versa. Trouble shooting during watch keeping Emergency measures taken in case of flooding of engine room Engine room bilge fire, general fire, breakage of pipe lines, blackout, Man/Eng Emergencies etc.

UNIT II TROUBLE SHOOTING IN AUXILIARY MACHINERIES
Malfunctioning, partial or total failure of auxiliary machineries Auxiliary engines, purifiers ,heat exchangers, air compressors Refer and air condition compressors and systems, boilers &accessories Fresh water generators, hydropore tanks & systems, all pumps systems Repairs and maintenance of propeller, rudder, dry rocking methods Dry docking inspection and repair works.

UNIT III TROUBLE SHOOTING IN MAIN ENGINES
Trouble shooting relates to various types of marine diesel engines Causes, effects, remedies and prevention of engine not turning on air Fuel, knocking at TDC and BDC, black smoke in funnel, poor compression Air starting line explosion, crank explosion, exhaust fire.

UNIT IV MAINTENANCE OF VARIOUS COMPONENTS OF MARINE DIESEL ENGINES
Checking of holding down bolts, resin chocking-tie rods tensioning Checking and tightening of 2-stroke and 4-stroke bottom end bolts Inspection and maintenance of crankshaft and can shaft, dismantle Reassemble of main bearings, cross head bearings & bottom end bearings Connecting rod, piston and piston assembly, stuffing box Checking of all clearances, adjustments, effects of improper clearances Cylinder liner and cylinder lubrication, thrust bearing, running gears Engine alignment, chains drive adjustment and tensioning

UNIT V TROUBLE SHOOTING AND MAINTENANCE OF ELECTRICAL MACHINERIES
Circuit testing, shore supply arrangement, maintenance of circuit breakers Transformers, electrical motors, navigational lights, batteries, starters Electrical equipments, maintenance of switch board Maintenance of electrical equipments in oil tankers, LNG/LPG.

TEXT BOOK
SEMESTER: VII ELECTIVE III

PERSONAL MANAGEMENT

UNIT I INTRODUCTION OF PERSONNEL MANAGEMENT, POLICIES & ITS FUNCTIONS.

UNIT II PERSONNEL MANAGEMENT IN INDIA, ORGANIZATIONAL STRUCTURE OF HRM.
Genesis and Growth – Qualification of labor welfare officer--Impediments to the progress of personnel management in India-Future role of personnel manager in India..

UNIT III PERSONNEL RECORDS, REPORTS, AUDIT AND RESEARCH, RECRUITMENT & SELECTION PROCESS.
Significance of Records and reports-Records-Essential of a good record and reports- Personnel audit-Objectives of personnel audit-importance of personnel audit-Manpower planning defined- Benefits and Responsibilities for the human resources planning. Recruitment- Factors affecting recruitment – Recruitment polices & organization – Recruitment practices in India and elsewhere.

UNIT IV PSYCHOLOGICAL TESTING-INTERVIEWS- EMPLOYEE SAFETY, MORALE ,MOTIVATION AND INDUSTRIAL HEALTH.

UNIT V WAGE, TRADE UNIONS,& CHALLENGES AHEAD FOR THE HRM .
Nature and purpose- Compensation, Reward, Wage levels and wage structures-Basic kinds of wages plans- Meaning, features, determinants of incentives-Classification or

TEXTBOOKS:

SEMESTER: VII  SKILL BASED SUBJECT V

MARINE PROPELLSIONS, OVERHAULING AND FIREFIGHTING LAB

MARINE PROPELLSION OVERHAULING LAB
(a) Main Routines:
1. Cleaning of Lubricating oil filters
2. Cleaning of Lubricating oil coolers.
3. Cleaning of Jacket water coolers.
4. Cleaning of Air coolers.
5. Crank case inspection.
6. Checking bearing clearances.
7. Main Engine over Hauling of cylinder heads and fittings.
8. Main Engine over hauling of fuel Injection pumps.
9. Cleaning of Turbo charger filters

(b) Auxiliary Routines:
1. Over hauling of cylinder head and fittings.
2. Checking tappet clearances.
3. Overhauling of air coolers.
4. Over hauling of fuel injection pump.
5. Crank case inspection and checking of all bearing clearances.
6. Overhauling of crank case relief door.
7. Overhauling of Turbocharger
8. Cleaning of air coolers

(c) FIRE FIGHTING LAB
1. Fire hazard aboard ships - inflammability, fire extinguishing use. Control of class A, B & C fires.
2. Fire protection built in ships, extinction systems and escape means.
3. System for tankers, statutory requirements for firefighting systems and equipments on different vessels.
4. Firefighting equipment: fire pumps, hydrants and hoses, couplings, nozzles and International shore connection, construction, Operation and merits of different types of portable extinguishers.
5. Non-portable and fixed fire extinguishers, installation for ships. Properties of chemical used, bulk carbon-di-oxide and inert gas systems.
6. Firemen outfit its use and care, maintenance, testing and recharging of appliances, preparation and fire appliance survey.
7. Fire control: Action required and practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boilers rooms, Cargo holds, galley etc.,
8. Fire fighting in port and dry dock. Procedure for re-entry after putting off fire, rescue operations from affected compartments.
10. Fire drill.