# 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

APPLIED MATHEMATICS - PAPER – I

UNIT – I Complex Variables

UNIT – II Vector Algebra and Calculus & Vector Analysis
Scalar and Vector Triple Products. Differentiation of a vector function of a single scalar variable. Derivative of a unit vector, application to curves in space, principal triad, senner - Frenet form.

UNIT – III Vector Analysis
Line integral, Green’s theorem for the plane, properties of line integrals, line integrals in space and their properties, application to work and to the flow of liquid, scalar and vector fields, conservative fields, potentials, gradient, divergence and curl, Divergence theorem, Stroke’s theorem, expressions for gradient, divergence and curl in orthogonal curvilinear co-ordinates, Gauss theorem, equation of heat flow, equations of hydrodynamics.

UNIT – IV Differential Calculus
Successive differentiation Standard form to find the nth derivative. Leibnitz’s theorem, Rolle’s theorem (with Proof), Lagrange’s and Cauchy’s mean value theorem (with proof); Taylor’s theorem, Taylor’s and Maclaurin’s series (without proof). Indeterminate forms, L’Hospital’s rule, Expansion of function in power series (all types), Partial derivatives of first and higher orders. Total differential, Concept of commutativity of partial derivatives (without proof). Euler’s theorem on homogeneous functions. Deduction from Euler theorems. Errors & Approximations. Maxima & Minima of the functions of two variables.

UNIT – V Differential equations
a) Exact differential equations and those which can be made exact by use of Integrating factors by inspection. (i) Linear equations and reducible to linear (Bernoulli) equations, (ii) Method of substitution to reduce the equation to one of the above forms.
b) Linear Equations of the nth order with constant coefficients. Complimentary function and particular integral when the function of the independent variable on R.H.S. is $e^{ax}$, $x^n$, $e^{ax}V(x)$, $\sin (a+b)$, $\cos (ax+b)$. Cauchy’s Linear equation (homogeneous). Legendre’s Linear equation. Variation of Parameters and method of indeterminate co efficient.
c) Elementary applications of above differential equations in solving engineering problems such as Electrical Engg., Mech. Eng.,

REFERENCE BOOKS
1. Elements of applied Mathematics Vol I Warlike, P. N & Weimar, J. N
SEMESTER: I  CORE PAPER I
NAUTICAL PHYSICS AND ELECTRONICS PAPER I

UNIT – I MECHANICS:

UNIT – II HYDROSTATICS, PROPERTIES OF MATTER&OSCILLATIONS

UNIT – III SOUND:–

UNIT – IV HEAT AND THERMODYNAMICS: -

UNIT – V LIGHT:–

REFERENCE BOOKS
2. Heat & Thermodynamics Brijlal & Subramaniam Ratan Prakashan Mandir
SEMESTER: I CORE PAPER II
PRINCIPLES OF NAVIGATION PAPER - I

UNIT – I
The shape of the earth, Poles, Equator, Great circles, Small circles, Parallels of latitude, Latitude, D’Lat, Meridians, Prime meridian, Longitude, D’long, Position by latitude & longitude.
Compass Points, True and Magnetic north. Magnetic variation and changes in its annual value. Isogonals. Deviation of magnetic compass, compass error, Course & Bearing. conversion of compass course to true course and vice versa.

UNIT – II
Departure Relationship between Departure and D’long, Parallel sating.
Rhomb Line, Mean latitude. Plane sailing, Relationship between departure d’lat, course and distance. Middle Latitude.
Principle of Gnomic projection: Mercator chart, Natural Scale, Meridional parts: DMP. Latitude and longitude scales and conversion of one to the other, Mercator sailing. Relationship between Course, D’long and DMP.

UNIT – III
Dead Reckoning position (DR), Estimated position (EP) & Observed position (Fix). Set and drift of current. Leeway.
Spherical triangle. Great circle sailing: initial course, final course, distance and vertex.
Solar system: Rotation and Revolution. Equinoxes and solstices. Cause of seasons and unequal length of day and night.
The Principle of the Sextant and the Azimuth Mirror.

UNIT – IV
Practical problems on parallel sailing using formulae.
Practical problems on plane sail using formulae
Practical problems on Mercator sailing using formulae.

UNIT – V
The use of Traverse Tables to obtain the position of the ship at any time, give compass course, variation, derivation and the run recorded by the log or estimated speed or engine speed allowing for the effects of wing and current, if any Day’s work.
To find initial course, final course and distance between two positions on the earth’s surface by Great Circle Sailing. To calculate the positions of the vertex and intermediate points on the Great Circle track.

REFERENCE BOOKS:-
1. Practical Navigation Capt. H. Subramaniam
SEMESTER: I CORE PAPER III
SHIP OPERATION TECHNOLOGY PAPER - I

UNIT – I BASIC CONCEPTS & LIFE SAVING APPLIANCES
Names of various parts of ship. Names and timings of watches. Types of merchant navy vessels.
Sea terms, Look-out. Compass points.
Cleaning of wooden decks. Cleaning and polishing of brass and copper.

UNIT – II LIFE SAVING APPLIANCES:

UNIT – III FIRE FIGHTING APPLIANCES:-
Description of portable fire extinguishers, various types and their suitability for different types of fires. Operation and refilling of fire extinguishers. Principle of fire extinguishing used in each type.
Safety devices: Fireman’s outfit, Smoke helmet and Self-contained Breathing Apparatus (SCBA).
Fixed smothering systems: Brief description of steam smothering system, carbon dioxide smothering system, Inert gas system, Flue gas system, Halon system, Foam smothering system for liquid fires, High expansion foam system.
Safety, care and maintenance of all fire fighting appliances.

UNIT – IV ROPES AND WIRES:-
Types of material used, natural fibers, synthetic fibers. Types of lay of ropes and their advantages. Plaited ropes. Characteristics of different types of fiber ropes. Comparison of strength and elasticity of different ropes. Care and maintenance of fiber ropes. Damage caused by surging. Meaning of Marline, spun yarn, oakum, tarred hemp; 3 ply and 5 ply twines, halliards, loglines, lead lines.
UNIT – V DECK APPLIANCES:
Description of the hand-lead line. Procedure for taking a cast.
Windlass & Cargo winches - description and their operation.

REFERENCE BOOKS
1. Life Boat and Life Raft Capt. Puri S.K
2. Survival at sea Wright C.H.
3. Theory and Practice of seamanship Danton G.
4. Seamanship Notes Kemp & Young
5. Nicholls Seamanship Brown Son & Ferguson Ltd.
6. Life saving Appliances Rules Govt. of India
7. Fire Fighting Appliances rules Govt. of India

SEMESTER: I  CORE PAPER IV  NAVAL ARCHITECTURE PAPER – I

UNIT – I
TYPES OF SHIPS: Types of ships based on nature of cargo. Passenger Liners, Ferrials.
Specialized carries for General Cargo, Bulk, Oil (Crude Oil and Products). OBO’s, Container, RO-RO, Lash, LPG, LNG, Cattle, Cars etc., Special features above types of ships.

UNIT – II
PRINCIPAL PARTS OF A SHIP: Bow, Stern, Shell plating, Double Bottom Tanks, Cargo Holds, Tween Decks, Deep Tanks, Fore-peak and after Peak store rooms and tanks, Plate Keels and Duet Keels, Forecastle deck, Quarter Deck, Main/Weather decks, Hatch covers, Cargo Gear, anchoring and mooring equipment.
SUPERSTRUCTURE: Wheel house, accommodation spaces, cabins, gallery, pantry, dining saloons, recreation rooms, various stores and lockers, cold storage spaces.
UNIT – III
GENERAL LAYOUT OF SHIPS:- General Cargo Ship, Bulk Carrier, Oil Tanker and container Ship. Simple sketches of the same.
PRINCIPLES OF DESIGN: Common principles governing design and construction of various types of steel ships with respect to:
   a) Longitudinal, transverse and vertical strength.
   b) Continuity of Strength
   c) Strength - under start and dynamic conditions.
   d) Stability
   e) Water - tightness
   f) Conformity with statutory requirements.

UNIT – IV
STEEL FOR SHIP CONSTRUCTION: Types of steel used in ship construction. Steel plates and their treatment. Rolled sections - various shapes and standard sizes. casting and forging and their use in construction. Testing of materials - various tests at production and building stages.

UNIT – V
Laws of flotation. Buoyancy, reserve buoyancy. Displacement, Deadweight. Change of a draft due to change of density. TPC, FWA, DWA. The centre of gravity of a ship and factors affecting the same. Calculations involving KG and KB of a ship. The meaning of the terms Block co-efficient, Mid-ship Coefficient, Prismatic Coefficient and relationship between them. Use of displacement and TPC curves and scales to determine weights of cargo or ballast from draughts or freeboards. Metacentric height, righting lever, Righting Moment. Stable, Unstable and Neutral equilibrium. Free surface Effect. Stiff and Tender ships. Difference between heel and list. Use of hydrostatic tables and curves as supplied to ships. Calculations based on the foregoing topics.

REFERENCE BOOKS
1. Ship Construction notes - Kemp & Young
2. Ship Construction for Engineers - Reid
3. Ship Construction - Pursey
4. Ship Stability I & II - Capt. Subramaniam H.
SEMESTER: II  ALLIED PAPER II

APPLIED MATHEMATICS PAPER - II

UNIT – I  INTEGRAL CALCULUS
Rectification of plane curves, Double & Triple integrals, their geometrical interpretation and evaluation. Evaluation of double integrals by change of order and change to polar form. Applications of double & triple integrals to areas and volumes Centre of Mass, Moment of Inertia, Applications of integration to the evaluation of first and second moments of areas and volumes.

UNIT – II  BETA & GAMA FUNCTIONS
a) Beta & Gama functions & their properties, relation between Beta & Gama functions.
b) Error functions
c) Differentiation under integral sign.

UNIT – III  INFINITE SERIES AND FOURIER SERIES
Convergence of infinite series, Uniform convergence, properties of uniformly convergent series, power series and their properties, expansion of a function as power series, Exponential and logarithmic series, Definition of Trigonometric and Fourier series, Fourier coefficients, Dirichlet’s conditions, statement of Dirichlet’s theorem, expansion of functions in Fourier Series, Even and Odd functions, half range Fourier series, Complex form of Fourier series, Differentiation and Integration of Fourier Series, Fourier series with respect to a set of orthogonal functions over (a,b). [Fourier series over (-π, π), (0,2π) and for arbitrary range (a,a+2L) must be treated]

UNIT – IV  SPHERICAL TRIGONOMETRY

UNIT – V  SIMPSON’S RULES
Derivation of Simpson’s first, second and five-eight rules and their use in the computation of areas, volumes and centroids.

REFERENCE BOOKS:
5. Integral Calculus  Shanti Narayan
SEMESTER: II  CORE PAPER V

NAUTICAL PHYSICS AND ELECTRONICS PAPER II

UNIT – I MAGNETISM

UNIT – II ELECTRICITY

UNIT – III ELECTROMAGNETISM
Magnetic Effect: Magnetic field due to a stationary coil, Electromagnet. Faraday-Lenz’s Law, transformer. DC motors - series and shunt wound. AC generator. AC circuits composed of R, L and C (series and parallel), reactance, impedance, series and parallel resonance, power factor. Three phase AC.

UNIT – IV ELECTRONICS
Semiconductors of p and n type, p-n junction diodes-their characteristic, half-wave, full wave rectifier. Zener Diode, its uses as a voltage regulator. Thermistors:- Use in temperature control. Transistors: - pnp,npn, 3 modes of Operation, current gains $\alpha$ and $\beta$. Photoelectric effect, opto-electronic devises-LDR, LED.7-Segment displays, photo diode, and photo transistor.

UNIT – V MODERN PHYSICS

REFERENCE BOOKS
2. Electronics Devices and Circuits Boylestead & Nashelsky Prentice Hall India.
4. University Physics Young, Sears, Zemansky Narosa Publishing
5. Electricity & Magnetism Brijilal & Subramaniam, Ratan Prakashan Mandir.
6. Modern Physics B.L. Thareja
7. Basic Electronics B.L. Thareja
SEMESTER: II CORE PAPER VI

VOYAGE PLANNING & COLLISION PREVENTION PAPER – I

VOYAGE PLANNING

UNIT – I
The Nautical chart. Natural Scale, types of projections, Title of Chart, Number of chart, Date of Publication. Deciphering the symbols and abbreviations used on a nautical chart. Units of Soundings used. How to read latitude and longitude. The use of parallel rulers to lay down or read courses and bearings. The Compass Rose. The distance scale. Use of dividers to measure distances. Reasons for using the nearest latitude scale for measuring distance. Correction from Notices to Mariners. To find the date the Chart was last brought up to date. Small and large Corrections. Degree of reliability of information shown on the chart. Type of Charts - Ocean charts, Coastal charts, harbor plans, Decca charts, Consol charts, Loran Charts, Routing charts. The use of the Admiralty Catalogue to identify the charts required for voyage.

UNIT – II

UNIT – III

COLLISION PREVENTION

UNIT – IV

Conduct of vessels in any condition of visibility:
Maintenance of Proper looks out. Maintenance of safe speed. Factors to be considered for determining safe speed. Determination of risk of collision with another vessel. Use of radar in determining risk of collision. Use of visual bearings. Types of actions to be taken to avoid collision or close quarter situation. Conduct of vessels in narrow channels and when approaching blind bends. Conduct of vessel in traffic separation schemes of International Maritime Organization.
UNIT – V
Conduct of vessels in sight of one another:
Responsibility to keep out of way when two sailing vessels are on collision course.
Responsibility to keep out of way when one vessel is overtaking another vessel of any type.
Action to be taken by a vessel when meeting another vessel head on.
Responsibility to keep out of way when two vessels are crossing each other.
Action to avoid collision. Duty of the vessel which has the right of way.
Action to be taken by such vessel required to keep out of way is not taking avoiding action.
Right of way between a normal power driven vessel not under command, a vessel restricted in her ability to manœuvre, a vessel engaged in fishing, a sailing vessel and a vessel constrained by her draft.

Conduct of Vessels in restricted visibility:
Applicability. Determination of risk of collision when another vessel is detected by radar alone. Action to be taken when for signal of another vessel is heard but vessel is not seen though it any have been detected by radar.

REFERENCE BOOKS
1. Chart work Capt. S.S. Chaudhari
2. Chart work for Mariners Capt. S. Puri S. K.
3. Voyage Planning & chart work Capt. M. V. Naik & Capt. Varty
5. Marine Chart work Moore, D.A.
6. Rules for the Prevention of collision at Sea Bhandarkar Publications
7. Rule of the Poad Manual Capt. Puri, S.K.
8. International Lights, Shapes and Sound Signals Moore D.A

SEMESTER: II CORE PAPER VII
CARGO WORK & MARINE COMMUNICATION
UNIT – I
CARGO GEAR - Blocks: Parts of a block, different types of block, non-toppling and snatch blocks. External binding. Internal binding. Strapped. Markings on a block. Size of a block and sheave, size of rope to be used in a block. Relationship between diameter of sheave and diameter of rope.
Tackles: Names of parts of a tackle, using a tackle to advantages or disadvantage. Mechanical advantage, velocity ratio or ‘power gained’, efficiency of a tackle; relationship between pull on the hauling part and load. Types of tackles/purchases used on ships.
UNIT – II
Shackles: Various types. Markings on cargo hooks.
Cargo hooks: various types. Markings on cargo hooks.
Ropes: Care of ropes and wires used for cargo hooks.
Derrick rigs: the Union purchases. Setting up of a union purchase. Importance of preventer guys.
Maximum load to be used for angle between runners. Swinging derrick with powered guys.

UNIT – III
Stresses: Calculating the stresses in various parts of a derrick rig. Calculating the tension on ropes and wires of a purchase and finding the correct size to be used.
Slings: Types of slings used for lifting cargo of different types. Accident prevention when working cargo.
Overhauling blocks: Care and maintenance. Reewing a three-fold purchase.

UNIT – IV
TRANSPORTATION OF GOODS BY SEA:- Categories of cargo, bulk solid, bulk liquid, chemical in bulk, gas, dangerous goods, general cargo, heavy lifts. Methods of carrying cargoes, tanks, containers, holds, portable tanks aboard ship, ro-ro, refrigerated containers and holds.
CARGO CARE:- Importance of cargo care to economical operation of ship. Care of cargo on board ship. Securing cargo by using Bull-dog grips and bottle screws. Securing by chains and tensioners. Container lashing and securing. Fire prevention, interaction, temperature, variations leading to sweat damage, sea water damage, ventilation to avoid hazardous gas accumulations, dunnage, Separations, bulkheads, shifting boards.

UNIT – V
MARINE COMMUNICATION
Meaning of bunting, halyard, at the dip, close up, half mast, hoist, fly, tack line.
Courtesy flag, ship’s numbers, jack flag, quarantine flag, Blue Peter.
Location on a ship of jack staff. Ensign staff, Gaff, Triatic stay, Foremast Yardarm, Main mast head. What flags are hoisted from these part of ship and when.
Types of ensign. Penalty for not using or wrongly using an ensign.

REFERENCE BOOKS
1. Theory and Practice of Seamanship Danton G.
2. Seamanship Notes Kemp & young
3. Nicholls Seamanship Brown Son & Ferguson Ltd.,
4. Cargo work Kemp & Young
7. International Code of signals HMSO
SEMESTER: II  CORE PAPER VIII
MARINE CONTROL SYSTEMS PAPER – I

UNIT – I MATERIAL BEHAVIOR:
Strength of materials - Elasticity, Hook’s law - stress and strain
Tensile, Compressive and Shear forces.
Failure of materials under tension, compression, shear and fatigue. Examples related to marine engineering.

UNIT – II
Cantilever and simply supported beams, shear force and bending moments, calculation of stresses and B.M. diagrams for above and other systems of the ship.
Mechanical properties of common engineering materials - hardness, ductility, malleability, melting point etc.

UNIT – III
Fluid mechanics - flow of liquids and gases, laminar and turbulent flow, resistance to flow.
Viscosity - definition and meaning.
Bernoulli’s theory - simple treatment.
Loss of energy of fluid due to bends, friction, valves etc. Simple hydraulic equipments.
Thermodynamics - properties of steam; boiling point and effect of pressure on it; saturated, dry and superheated steam; Dryness fraction. Meaning of sensible heat and latent heat.

UNIT – IV ELECTRICAL SCIENCE:
Electrostatics, electro-magnetism and electricity. Electric current, voltage, emf, ohms law, direct current (dc) and alternating current (ac). Simple electrical circuits, Kirchhoff’s laws, simple calculations, Wheatstone bridge.

UNIT – V MARINE SCIENCE PRACTICE:
General introduction and scope. Classification of ships as per propulsion plants. General layout of ships engine rooms and machinery. Main engine plants and supporting systems. Introduction about ships auxiliary systems. Electrical power generation plants - its supporting systems and importance. Bilge, ballast, fire cargo and other pipelines of different type of ships.

REFERENCE BOOKS
1. Basic Marine Engineering J.K. Dhar
2. Engineering Drawing Bhat
3. Engineering Knowledge for Deck Officers Reed
4. General Engineering Knowledge Vol:8 Reed
5. Mechanical Engineering Science Hannah & Hiller
6. Marine Auxiliary Machinery Souchette & Smith
**SEMESTER: II  CORE PRACTICAL I**

**VOYAGE PLANNING & COLLISION PREVENTION PRACTICAL – I**

**COLLISION PREVENTION**  
Syllabus same as theory

**VIYAGE PLANNING**  
To find compass error by transit bearings.

To find the position of a point on the chart by its latitude and longitude.

To find the position of a point on the chart by its bearing and distance from a navigational mark.

To plot ship’s position using three shore objects by horizontal sextant angles (given Horizontal sextant angle less than 90, equal to 90, or greater than 90).

To plot ship’s position, given vertical sextant angles and bearing of a light house.

To plot position, lines obtained by an astronomical observation.

To find compass course between two positions on the chart.

To find compass course to seer between two positions on the chart so as to counteract the given set and drift of current and given leeway.

To find the course and distance made good, given course steered, set and drift of current and leeway.

To find the course and speed made good and the drift, given the course steered, speed, duration and the initial and final observed positions.

To find the course from a given position so as to pass a lighthouse at a given position so as to pass a lighthouse at a given distance when abeam.

**REFERENCE BOOKS:**

1. Chart work  
   Capt. S.S. Chaudhari

2. Chart work for Mariners  
   Capt. S. Puri S. K.

3. Voyage Planning & chart work  
   Capt. M. V. Naik & Capt. Varty

4. Nicholls Concise Guide Volume I  
   Brown Son & Ferguson

5. Marine Chart work  
   Moore, D.A.

6. Rules for the Prevention of collision at Sea  
   Bhandarkar Publications

7. Rule of the Poad Manual  
   Capt. Puri, S.K.

8. International Lights, Shapes and Sound Signals  
   Moore D.A
SEMESTER: III  ALLIED PAPER III  
APPLIED MATHEMATICS PAPER – III

UNIT – I  BESSEL FUNCTIONS AND LEGENDRE POLYNOMIALS:
Relations between Laplace equation and Bessel’s differential equation, Bessel functions of first and second kind, recurrence relations for J(x), Generating function of J(x), Orthogonality of J(x), Bessel-Fourier series of a function, relation between Laplace equation and Legendre, differential equation, Recurrence relations for Pn(x), Rodrigues formula for Pn(x), Generating function of Pn(x), Orthogonality of Pn(x), Legendre – Fourier series for a function.

UNIT – II  PARTIAL DIFFERENTIAL EQUATIONS:
Partial differential equation governing Transverse Vibrations of an elastic string, its solution using Fourier series, Vibrations of rectangular and circular membranes. Heat equation, steady – state configuration for heat flow and Laplace equation in two and three dimensions,

UNIT – III  LAPLACE TRANSFORMS:
Laplace transforms of 1, t^n, e^{at}, sin(at), cos(at), Sin h(at), Cos h (at), crf(t), Shifting properties, Expressions (with Proofs) for:
(i) L(t^n f(t))  ii)L (f(u)du   iii) L(f(t)/t)
0
Unit step functions (or) Heaviside, Dirac functions and their Laplace transform.

UNIT – IV
Laplace transform of periodic functions.
Evaluation of inverse Laplace Transforms, partial fraction methods, convolution theorem.
Application to solve initial and boundary value problems involving ordinary differential equations with one dependant variable.

UNIT – V  COMPLEX VARIABLES
Functions of complex variable. Continuity (only statement) derivability of a function Analytic. Regular function. Necessary conditions for f(z) to be analytic. (Statement of sufficient conditions). Cauchy Riemann equation in polar co-ordinates. Harmonic functions. Analytical and Milne — Thomson method to find f(z) from its real or imaginary parts. Integration of complex functions, Cauchy’s integral theorem for simply connected regions, Cauchy’s integral formula, Taylor’s and Laurent’s expansion. Zeros, Singularities, poles, residue at isolated singularity and its evaluation. Residue theorem, its application to evaluate real integrals.

REFERENCE BOOKS
2. Sastry S. S Engineering Mathematics (Vol. 2)
3. Santi Narayan Theory of Functions of a Complex Variable
4. Wilfred Kalpan Advanced Calculus
5. Schaum’s Outline Series Laplace Transforms
6. Dr. Grewal B.S Higher Engineering Mathematics
SEMESTER: III CORE PAPER IX
NAUTICAL PHYSICS & ELECTRONICS PAPER – III

UNIT – I REVIEW OF A.C. CIRCUITS
Self inductance, inductive reactance, purely inductive circuit, a.c. through resistance and inductance, choke, numerical problems. Capacitance, capacitive reactance, purely capacitive circuit, a.c. through capacitance, and resistance, numerical Problems. Impedance, admittance, A.C through L-C-R circuit, series and parallel resonant circuits, power and power factor in a .c. circuits, numerical problems.

UNIT – II MODULATION & DEMODULATION TECHNIQUES:

UNIT – III TRANSMISSION SYSTEMS & DIGITAL COMMUNICATIONS:
Classification of amplifiers — A, B and C, AF, RF and power amplifier, SSB (Single side band) transmitter, sideband filters, Types of pulse modulation, generation and demodulation of Pulse Amplitude Modulation (PAM) waves, distortion in PAM, pulse Duration (width) Modulation (PWM or PDM), Pulse position Modulation (PPM), generation and demodulation of PPM, Pulse code Modulation (PCM), generation and demodulation of PCM.

UNIT – IV WAVE PROPAGATION, ANTENNAS & RADIO RECEIVERS:
Basic electromagnetic spectrum, mechanism of wave propagation, field strength, propagation through troposphere, Propagation models, radio horizon, troposphere monitoring techniques, sky — wave propagation, ionosphere, microwave links and other communication links, noise in communication systems, Antennas- Yagi - Uda antenna, Rhombic antenna, microwave antenna, active antenna, horn antenna, dielectric antenna, tuned RF receivers, super heterodyne receivers. AM receivers, stereo FM multiplexed reception, single side band receiver, noise consideration, FM receiver performance.

UNIT – V RADAR & SATELLITE COMMUNICATION:
Elements of radar system, radar rang, limitations of radar, radar altimeters and beacons interrogating radars, Instrument Landing System (ILS), Visual VHF Omni Range (VOR) Tactical Air Navigation (TACAN), Radio Direction Finding (RDF), Satellite links, ellipses, orbits and inclination, satellite construction, communication frequencies, domestic satellites, telemetry.

REFERENCE BOOKS:
3. Electronic Communications : D Roddy J Coolen
4. Electronic Communication System : G. Kennedy
5. Communication Electronics : N.D. Deshpande, D.A. Deshpande, P.K. Rangole
7. Operational Amplifiers and Linear Integrated Circuits: Coughlin and Driscoll
8. Electronic device and circuit theory : Boylestad and Nashelsky
SEMESTER: III CORE PAPER X
VOYAGE PLANNING & COLLISION PREVENTION PAPER II

VOYAGE PLANNING
UNIT – I
Elementary knowledge of Passage Planning and its execution. Landfall in thick and clear
weather. The selection of a suitable anchorage.
To find the time and height of high and low water at Standard ports. The use of admiralty Tide
tables and tidal curves to find the time at which the tide reaches a specified height or heights of
the tide at a given time and thence the correction to be applied to soundings or charted heights of
Shore objects.

UNIT – II
The interpretation of a chart or plan, particularly the information given about Lights, Buoys
Radio Beacons and other Navigational Aids. Depths and height contours. Tidal Streams Traffic
lanes and separation zones. Recognition of the coast and radar responsive targets Chart
correction.

UNIT – III
Geographical range, Luminous Range, Nominal Range; and their significance.
Development of electronic Chart display system

COLLISION PREVENTION
UNIT – IV
More detailed knowledge of ‘International Regulations for Preventing Collision at Sea’ than that
at the first year level.
The IALA system of Buoyage – lateral and cardinal systems.

UNIT – V
Precautions while using floating navigational aids such as buoys, light vessels etc.

REFERENCE BOOKS
1. Rule of the Road: Bhandarkar Publication
2. International Light, Shape and Sound Signals: D.A. Moore
3. Guide to collision avoidance: Cockroft
4. Maritime Buoyage System : I.A.L.A
5. Chart Work : Capt. S.K. Puri
6. Modern Chart Work : Squair
7. Navigation for Watch Keepers : Fifield
11. Marine Chart Work : D.A. Moore
SEMESTER: III CORE PAPER XI
MARINE CONTROL SYSTEMS PAPER II

UNIT – I MATERIAL SCIENCE
Steels – Elementary metallurgy of steels, steel production – smelting & refining.
Iron-Carbon diagrams to show role of carbon in steels and effect on properties.
Diagram to show role of carbon in steels and effect on properties. Types of steel and use.
Heat treatment – Heat treatment of steels – obtaining desired properties from steel for use in different areas.

UNIT – II ELECTRICAL SCIENCE
Transformers: high and low voltage transformers, step up / step down / transformers, transformer efficiency and maintenance and care.
Power distribution : Main switch boards , power distribution boards, Circuits breakers, Measuring instruments , overload trip short circuit trip, fuses other protections.

UNIT – III MARINE SCIENCE – Auxiliaries
Compressed air: Air compressor, uses of compressed air. Storage and distribution of compressed air.

UNIT – IV
Pumps : working principle, construction of different types of pumps . Selection of pumps for different duties on board the ship.
Steering : Common types of steering gear, Electro hydraulic steering gears, two and four Ram systems , telemotor and control systems . Safety features. Emergency arrangements. Legislation National and international, operations and maintenance.

UNIT – V
INTERNAL COMBUSTION ENGINE:
Working principles : classification of various types of engines, various types of modern diesel engines. Basic principles of cycles, P-V diagrams, work done etc. 4 stroke and 2 stroke engines.
Components: construction, main components and working of 2 & 4 stroke engines.

**REFERENCE BOOKS**

1. Basic Marine Engineering by J. K. Dhar, G. Maritime
2. General Engineering Knowledge for Marine Engineers: L. Jackson and T. Morton
4. Basic Electro Technology for Engineers: Thomas Reed Publications Ltd.
6. Marine Auxiliary Machinery: DW Smith, Butterworth
7. Marine Electrical Practice: Butterworth

**SEMESTER: III  ELECTIVE PAPER I**

**BRIDGE PROCEDURES AND LEGAL KNOWLEDGE**

**UNIT – I – BRIDGE EQUIPMENT**

Guidelines for watch keeping at sea and in port
Basic principles and use of radar
Principle of position fixing by hyperbolic lattice. Use of radio waves to obtain difference of distances by measurement of time difference or phase difference. Elementary knowledge of instruments using the above principle.

**UNIT – II – MARINE COMMUNICATION**

Introduction and use of Radio Communication Equipment on board ship for distress and safety selection of suitable frequencies.
Radio Regulations relating to maritime Services including maritime frequency allocation.
Global Maritime Distress and safety System – Principles and actual applications.
World Wide Navigational Warning System – India’s role as a coordinator for area 8.
Meteorological Broadcast – Routine weather messages and storm warnings
Search and Rescue Communications

**UNIT – III – LEGAL KNOWLEDGE**

Merchant Shipping act 1958 with special reference to General Administration, Procedure and Certificate of Registry, Passenger Ships, Certificates and other documents required to be carried on a ship – How obtained and their validity.
Certificate of Officers, Seaman and Apprentices, Engagement, Management, and discharge of crew, Manning scales and Contracts of employment, Wages and other remuneration, advances, allotments, Money orders, payments into bank accounts. Desertion, deceased seaman, engagement of substitutes, repatriation.
UNIT – IV
The Official Log Book and the law relating to entries therein. Offences relating to misconduct to endangering ship against persons on board. Discipline and treatment to disciplinary offences.
Crew accommodation. Hygiene of the ship and welfare of the Crew. Inspection and reports.
Fresh water and provisions. Procedure in cases of infectious diseases, illness or accident.
Maritime declaration of health. Port health requirements.
Custom House procedure, entering and clearing ship.

UNIT – V
Load Line marks, Entries and reports in respect of freeboard. Draft and allowances. Calculations on Lay days and Load Line (Zone Problems).
Safety of the ship, crew and passengers. Assistance to vessels in distress and salvage. Duties of Master in the Case of an accident.
The law relating to the reporting of derelicts, tropical revolving storms and other dangers to navigation.
Compulsory and non-compulsory pilotage.
A General knowledge of shipping practice and documents with particular reference to charter parties, bills of lading and Mates receipts. The law relating to carriage of cargo and the ship owners liabilities and responsibilities. Protests, certificate of seaworthiness.
A knowledge of the contents of “Merchant Shipping Notices” and Notices to Mariners. The use of Notices to Mariners.

REFERENCE BOOKS
1. Electronic Navigation Aids: Sonnenberg
2. Ship Borne Radar: Capt. H. Subramaniam
4. Telecom handbook for Radio operators
5. Business and Law for ship Master: Hopkins
7. Ship’s Business: Bonwick and Steer
8. SOLAS: IMO Publication
9. MARPOL: IMO Publication
11. Medical First Aid guide: IMO Publication
13. Annual Notices to Mariners: Hydrographic department
14. Weekly notices to Mariners: Hydrographic department
15. Merchant Shipping Notices: Bhandarkar Publications
SEMESTER: III  SKILL BASED SUBJECT
ENVIRONMENTAL SCIENCE PAPER – I

PHYSICAL METEOROLOGY
UNIT – I

UNIT – II
Water Vapour in the Atmosphere: Changes of state, specific, absolute and relative humidity, dew point temperature, humidity mixing ratio. Unsaturated and saturated states, super cooling, frost point. Diurnal and seasonal variation of water vapour.

UNIT – III

OCEANOGRAPHY
UNIT – IV

UNIT – V

REFERENCE BOOKS

<table>
<thead>
<tr>
<th>TITLE</th>
<th>AUTHOR</th>
<th>PUBLISHERS</th>
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<tr>
<td>Marine Meteorology</td>
<td>Capt. H. Subramaniam</td>
<td>Vijaya Publications</td>
</tr>
</tbody>
</table>
SEMESTER: III  PRACTICAL II

VOYAGE PLANNING & COLLISION PREVENTION PRACTICAL II

VOYAGE PLANNING

1. To determine ship’s position by the ‘Running Fix’ method with and without current.
2. To find the ship’s position by ‘doubling the angle on the Bow’ method
3. The use of a station pointer to plot ship’s position – given two horizontal angles.
4. Use of single position line obtained from a celestial observation when near a coast to keep safe distance off the coast.
5. Fixing the position of a ship using bearings obtained from a D.F. set. Conversion of DF bearing to Mercator bearing
6. To find course made good using the three point bearing method.

COLLISION PREVENTION

1. The students will be required to identify various collision situations by day and by night.
2. Practicals to be held using a magnetic board, wooden models, overhead projector, video tapes or any other aid to simulate such conditions
3. Candidates will be required to deal with each collision situation broadly under the headings ‘recognition’, ‘responsibility’, ‘action’, ‘appropriate sound signal and ‘ordinary practice of seaman.
4. Collision situation in restricted visibility with or without Radar. Statutory obligations under both circumstances.
5. Recognition of various buoys and marks under IALA system and appropriate actions required under the rules.

Note: The third semester examination will include the entire Practical portion of the 2nd year.
REFERENCE BOOKS

1. Rule of the Road : Bhandarkar Publication
2. International Light, Shape and Sound Signals : D.A. Moore
3. Guide to collision avoidance : Cockroft
4. Maritime Buoyage System : I.A.L.A
5. Chart Work : Capt. S.K. Puri
6. Modern Chart Work : Squair
7. Navigation for Watch Keepers : Fifield
11. Marine Chart Work : D.A. Moore

SEMESTER: IV ALLIED PAPER
APPLIED MATHEMATICS PAPER – IV

UNIT – I
NUMERICAL METHODS :

UNIT – II

UNIT – III
Matrices
UNIT – IV
Statistics :
Frequency distribution, Measures of central tendency; Mean, Median and Mode, measures of variability, range, Percentiles, Variance, Standard Deviation, Skewness, Moments, Coefficient of Correlation, Lines of Regression – Rank correlation.

UNIT – V

REFERENCE BOOKS
2. A text book of Matrices Shanti Narayan
3. Mathematical Statics Kanpur J.N. and Saxena H.C.
4. Statistics in Schaum’s Series Murray Spiegal
5. Statistics and Probability for Engineers Myers
6. Higher Engineering Mathematics: Dr. Grewal B.S.

SEMESTER: IV  CORE PAPER XII
COMPUTER SCIENCE

UNIT – I COMPUTER FUNDAMENTALS:
Historical development of computers an evolution. Classification of Computers on different norms such as generations, technology, etc. Different functional parts of a computer and their functions. Computer peripherals: Monitor, Printer, Key board, Floppy Disk Drive, Floppy, Hard disk, Mouse, Computer arithmetic: Binary, Octal, Decimal & Hexadecimal number systems and mutual conversion:

UNIT – II
Addition, 1’s & 2’s complementation in binary only. Units of memory measurement: Bits, KB, MB, GB, TB. Units of run – time measurement: sec, ms, µs, ns, ps, fs, as. Different computer environments: Batch processing, time sharing, Interactive & Network, their functional details and differences. Computer connectivity: LAN, MAN, WNA, Internet. Internet activity in India and various facilities available on Internet, Satellite based communication.

UNIT – III – C LANGUAGE
UNIT – IV

UNIT – V PRACTICALS:
Programs are to be written, tested and filled for certification by teacher / head of Institution:

1. Finding n
2. Finding GCD of two numbers
3. Solution of a quadratic equation
4. simple and compound interest
5. Mean and standard deviation
6. Sorting of numbers
7. Finding real distinct roots of an algebraic equation: Newton – Raphson method
8. Creating a database of students using file operations
9. Creating and manipulating a singly linked-list

REFERENCE BOOKS
1. Turbo C reference Manual
3. Mastering turbo C: Kelly/Bootle : BPB
4. Turbo C Programming techniques: Stevens A. : BPB
5. Computer Virus – prevention, detection & removal : Kanpur R: BPB
6. Introduction to computer science vol. I & II : Jain S. BPB
7. Introducing computers I, II & II: Mehta S. : BPB

SEMESTER: IV CORE PAPER XIII
NAUTICAL PHYSICS & ELECTRONICS PAPER – IV

UNIT – I - ANALOG CIRCUITS
Transistor Biasing & Amplifier : Operating Point, Base bias (Fixed bias), Emitter bias, Voltage divider bias, D.C. load lines, Transistors saturation, Transistors as a switch,C.E. amplifier, DC and AC equivalent circuits, voltage gain, current gain, Input and output impedance, Frequency response, Class A operation, Power gain, A typical emitter follower circuit.

UNIT – II
Operational Amplifier & Feedback Types: The basic differential and Common Mode Operation, Basic Op-amp Specifications, Inverting and Non-inverting amplifiers, voltage follower,
summing amplifier, Difference Amplifier. Integrator and Differentiator, Voltage and current feedback, Effects of negative feedback on amplifier parameters, typical single transistor circuits for voltage series and current series feedback. RC oscillators –Wein Bridge (opamp and transistors), LC oscillators – Colpitts and Hartely (transistor and op-amp), crystal oscillator.

UNIT – III
CRO, Clocks and Timers: - construction, working, basic measurements, 555 timer, basic timing concept, 555 block diagram, mono stable and astable multi vibrators, Voltage controlled Oscillator (VCO).

UNIT – IV - DIGITAL CIRCUITS
Number System and Logic gates: Binary numbers, binary to decimal conversion, decimal binary conversion, (Octal and hexadecimal numbers, Binary to octal and binary to Octal and binary – Hexadecimal inter conversion), NOT, OR, AND, NAND, NOR Logic gates, EXOR Gate, arithmetic a data processing circuits (half adder, full adder, multiplexer and de multiplexer), De Morgan Theorems, Boolean algebra, NAND and NOR as a basic building blocks, Flip flops and counters: RS flip flop, Clocked RS flip flop, D flip flop, JK flip-flop, Master Slave concept, Schmitt trigger, Flip-Flops used as binary ripple counters, decade counter.

UNIT – V
Microprocessors: The 8085 microprocessor, memory interfacing, basic interfacing concepts, interfacing output displays and input devices, memory mapped I/O, 8085 programming model, instruction classification, instruction format, how to write, assemble and execute a simple program, overview of 8085 instruction set.

REFERENCES BOOKS:
2. BN: Electronic devices and circuit theory - 5th ed., PHI (Printice Hall India) - Bolystance and Nashelesky.
5. Digital Principles and Applications : Malvino & Leach
6. Operational Amplifiers and Linear Integrated Circuits : Coughlin and Driscoll
8 Microprocessor Architecture, Programming and Application : R.S. Gaonker.
UNIT – I
The celestial sphere, celestial poles, equinoctial, declination, celestial meridians, vertical circles, prime vertical, Ecliptic, First point of Aries, RA, SHA, GHA, LHA. V and d corrections for moon and planets. Position of a heavenly body on celestial sphere by its declination and GHA, or by its altitude and azimuth, or by its celestial latitude and longitude.

Visible, sensible and rational horizons, zenith, nadir, sextant altitude, apparent altitude, correction of altitude, dip, refraction, semi – diameter, parallax in altitude, horizontal parallax, augmentation to moon’s S.D, reduction to H.P. True altitude and True Zenith dist. Total correction tables. Artificial horizon & correction of altitudes there from; back angle altitudes.

True and apparent motion of bodies. Solar time, Solar day, apparent sun, mean sun and dynamical mean sun; equation of time. Time and hour angle, Hour circles, Greenwich time local time, zone time & standard time. Keeping time at sea, advancing & retarding of clocks with change of longitude; International date line.

UNIT – II
Sidereal time, sidereal day, why stars rise four minutes earlier each day, conversion of solar time to sidereal time and vice-versa 5. Azimuths and amplitudes: Derivation of formula: Sin amp = Sin decl. Sec lat. Apparent altitude of Sun, Moon at time of theoretical rising or setting

Rising culmination and setting of heavenly bodies. To find time of meridian passage, sunrise, sunset, moon rise and moon set by calculation and by perusal of nautical almanac with appropriate correction.

UNIT – III
Principles of position lines. Geographical position, circle of position, why P/L is at right angles to the Azimuth – exceptions. Positions to draw the P/L – Intercept method; Longitude by chronometer method and Ex-meridian method. Effect of change of DR position on position for P/L and practical applications.

Simple calculations on 1 to 7above.

UNIT – IV
To find the true Azimuth of a heavenly body, the compass error and hence the deviation of the magnetic compass for the direction of the ship’s head (ABC tables)

To find the compass error and deviation from amplitude of Sun and Moon.

To find the latitude by meridional altitude of a heavenly body. To calculate meridian passage time and approx meridian altitude for setting on the sextant (computed altitude)
Latitude and position line by observation of Polaris.
UNIT – V
From an observation of any heavenly body near the meridian, to find the direction of the position line and latitude corresponding to the D.R. longitude through which the passes. Time limits for ex-meridian sight.

To find the longitude corresponding to the DR latitude through which the position line passed and the direction of position line from an observation of any heavenly body. (long by chron).

To find the intercept, intercept termination point and direction of position line from observation of any heavenly body. (intercept method).

REFERENCE BOOKS

1. Principles of Navigation : Capt. P.M. Sharma
5. Navigation : A. Frost
7. Nutshell Booklet on Sextant : Capt. H. Subramaniam

SEMESTER: IV CORE PAPER XV
SHIP OPERATION TECHNOLOGY PAPER II

UNIT – I
Introduction to codes and guidelines for carriage of bulk chemicals, bulk gas.
Planning stowage of general cargo taking into account stowage factor, port rotation, hazardous nature, special stowage requirements relating to cargoes not covered by special codes.
Principles of stowage/ securing of all types cargoes taking into account ship’s motion at sea.
Factory act. Requirements for annealing and periodical testing of Cargo gear, chain register other requirements of the Factory Act.

UNIT – II
Safety of personnel in handling any type of goods using EMS, MFAG, code of safety practices for merchant seaman, General outline knowledge of Indian Dock Labour Regulations.
Machinery for handling of cargoes such as : Derrick and rigs, Cranes, Heavy lift crane / derrick, Winches including self tension winch, Conveyor belt/ chute arrangements, container handling systems.
Infrastructure built in ports for loading and discharging, such as cranes, gantries, conveyor belt system etc.
Calculations relating to above topics where applicable.
UNIT – III
SURVIVAL AT SEA: Boat drills and musters. Action prior to, and after abandoning ship. Managing the craft and personnel in the craft. Handling of the craft. Landing signals. An outline knowledge of SOLAS requirements of LIFE SAVING APPLIANCES.

UNIT – IV
FIRE PREVENTION AND FIRE FIGHTING: Causes of fire. The fire triangle. Principles of fire fighting. Types of fire and methods of extinguishing each type. Various methods of detection and fighting of fire. Causes of fires in tankers during various operations carried out by tankers and its prevention methods. Outline knowledge of SOLAS requirements on FFA.


UNIT – V
Properties and uses of paints resins and other protective coverings. Preparations for dry docking and undocking. Use of side shores, bilge blocks and bilge shores. Measures to be taken to prevent spillage of oil during cargo work, bunkering or oil transfer. Keeping oil record book.

REFERENCE BOOKS
1. Cargo Work : Kemp and Young
2. Stowage of Cargo : O.O. Thomas
3. Theory and Practice of Seamanship : Danton
4. Seamanship Notes : Kemp and Young
5. Seamanship and Nautical knowledge : Nicholls
7. Life boat and Life raft : Capt. S.K. Puri
SEMESTER: IV CORE PAPER XVI

NAVAL ARCHITECTURE PAPER II

UNIT – I
Use of Simpson’s rules in the computation of areas, volumes and centroids.
Determination of position of the longitudinal center of gravity of a ship for different conditions of load and ballast. The effect on the position of center of gravity of a ship by adding, removing and/or shifting weights.
Longitudinal center of buoyancy, Longitudinal metacentre and center of flotation and factors affecting their positions.
Theory of Trim. Changes of trim and draft due to loading, discharging and shifting weights.
Change of trim due to change of density.

UNIT – II
Use of stability, hydrostatic and stress data supplied to ships.
Cross curves of stability, K.N. values, determination of Righting moment using K.N. values,
Curve of statical stability and its practical usage.
Carriage of deck cargoes and their effect on stability.
Stowage of grain and stability aspects in respect thereof with particular reference to calculations involved and the manner of presentation of the information relating to grain heeling Moments and the resulting angle of heel as presented in the National Statutory Regulations.
Calculations based on the foregoing including those based on “Trim and Stability Particulars” of a given ship.

UNIT – III
Longitudinal and transverse framing, Beams and Beam knees. Functions, construction and stiffening of water tight bulkheads including collision bulkhead. Shell and deck plating.
Bilge Keels. Double bottom and peak tanks. Side and wing tank. Bilges.
Construction, stiffening and closing arrangements of openings on deck and superstructures.
Sounding pipes, air pipes, ventilators. Hawse-pipes, spurling pipes and their securing arrangements.

UNIT – IV
General pumping arrangements – Bilge and ballast line systems. Pumping arrangements on tankers. Methods adopted to maintain integrity of divisions and opening in the hull including stern, side and bow doors.
Rudders, construction and support. Stern frame, Propellers and Propeller shaft; stern tube and adjacent structure.
General ideas on various plan supplied by shipyard. Mid ship sections of General cargo ship, tanker, bulk carrier, container, OBO.

UNIT – V
Stress and strains in ships in still water and in a seaway. Parts of ship specially strengthened and stiffened to resist such stresses including panting and pounding. Causes and methods of
corrosion control in steel work and also between dissimilar metals including cathodic protection. Impressed current systems. An outline knowledge of the functions of Clarification Societies. Surveys for assignments and retention of class.

REFERENCE BOOKS

2. Merchant Ship Stability for Masters and Mates : Deret
3. Notes on Stability : Kemp and Young
4. Stability for Merchant Ships : Capt. Lester
5. Stability : La Dage and Gemert
7. Ship Construction for Marine Students : Reeds
8. Ship Construction : Kemp and Young
9. Ship Construction : Eyres
10. Ship Construction : Pursey
11. Ship Construction : Taylor
12. Grain Code : IMO.

SEMESTER: V CORE PAPER XVII
PRINCIPLES OF NAVIGATION PAPER III

UNIT – I

UNIT – II
Twilight – Civil, nautical and astronomical – conditions necessary for twilight all night; calculation of time of twilight by perusal of almanac with appropriate corrections, simple calculations based on above. Circumpolar bodies; conditions necessary for a body to be circumpolar. Maximum azimuth. Problems on these topics. Great circle sailing – Initial & Final courses and distances, Pole, Vertex, course on crossing the equator. Figure drawing of a GC track approximately to scale. Composite great circle sailing.

UNIT – III
Relationship between tides & phases of the moon – spring and neap tides; priming & lagging. Familiarity with all the contents of nautical almanac and its usage.
Calculations based on 1st and 2nd year’s portion of Principles of Navigation, together with (1) to (7) above.

UNIT – IV
Solution of Spherical triangle by Haversine formula. Sine formula. Cosine formula, Four part formula & Napier’s Analogies.
Application of right angled & quadrantal spherical triangles.
To obtain a position by use of position lines obtained from two more observations with or without run (Simultaneous or staggered). The cocked hat and its interpretations.

UNIT – V
Practical problems on Great Circle sailing. Use of ABC tables to find initial course, final course, Pole and Vertex of a Great Circle & great circle distance. Practical problems on composite circle. Calculations based on 1st and 2yrs. Portion of Practical Navigation, together with (1) to (4) above.

REFERENCE BOOKS
1. Principles of Navigation : Capt. P.M. Sharma
2. Practical of Navigation : Capt. H. Subramaniam
4. Principles and Practice of Navigation : A. Frost

SEMESTER: V  CORE PAPER XVIII
SHIP OPERATION TECHNOLOGY PAPER – III

UNIT – I
Study of IMO codes and guidelines for the carriage of dangerous goods, timber, chemicals in bulks, liquefied gases in bulk, grain and bulk cargoes.
Detailed study of stowage and securing of various types of cargoes taking into account safety of ships and cargoes.
Cargo handling gear, designs and strength parameter, special requirements for handling of bulk cargoes and containers.

UNIT – II
Principles involving the carriage of oil, chemicals and gases in bulk. Procedure to follow at tanker terminals. Detail study of tanker terminal codes for handling of petroleum products, bulk liquid chemicals and liquefied gases. Avoidance of accidental pollution’s and precautions to be taken.
UNIT – III

UNIT – IV
Study of Bulk carriers with respect to: Loading, discharging, ballasting, deballasting operations. Precautions to be taken for high density cargoes, grain and concentrates. Calculations relating to above topics.

UNIT – V
Basic knowledge of the various components of a shipboard GMDSS station. Communication procedures under GMDSS in Distress & Safety situations in accordance with regulations contained in SOLAS, ITU and other publications.

REFERENCE BOOKS
1. Cargo Work : Kemp and Young
2. Seamanship and Cargo Work : Capt. J. Dinger
3. Cargo Work : Capt. L.G. Taylor
4. Stowage of Cargo Work : O.O. Thomas
5. Grain Rules : IMO
6. Code of Safe practice for Bulk Cargo : IMO
7. International Bulk Chemicals Code : IMO
9. MARPOL 73/78 Consolidated Edition : IMO
10. Load Line Convention 1966 : IMO
11. Guide lines for Tank Washing with Crude Oil : ICS
12. The Chemistry of Oil Tankers Fires and Inert Gas System : Capt. G.S. Heredia
13. Tanker Handbook for Officers : Capt. C. Baptist
14. Tanker Practice : G.A.B. King
15. Tanker Practice : Rutherford
18. International Volume of Radio Signals : HMSO
20. GMDSS for GOC : Clifford Merchant
SEMESTER: V  CORE PAPER XIX

NAVAL ARCHITECTURE PAPER III

UNIT – I  SHIP STABILITY
Use of Simpson’s Rules for the computation of areas, second moment of areas, volumes, moments of volumes and centroids, Centre of pressure for regular shapes and parabolic shapes, when given horizontal or vertical ordinates.
Derivation of the formulae for TPC, FWA, BM (Transverse), MCTC, Angle of Loll, Virtual loss of GM due to free surface, Virtual loss of GM on dry docking. List with zero GM, Wall sided formula and Attwood formula.
Stability at moderate and large angles of heel. Use of the wall-sided formula. Effect of beam and freeboard on stability.
Dynamical Stability – calculation of same by the GZ curve.
Stability and trim when dry-docking or grounding.

UNIT – II
Theory of rolling. Synchronism.
The danger to a ship at the angle of loll. Ballasting sequence to rectify same.
Dangers to a ship with a heavy list. Dangers associated with deck cargoes including timer preventive and corrective actions to take.
Bilging of compartment. Permeability of a compartment. Calculation on bilging and flooding of a compartment, symmetrical about center line anywhere along the ship’s length for a box-shaped vessel given center MCTC.

UNIT – III
The Inclining Experiment.
Shearing Forces and Bending Moment. The ship as a box girder. The calculation, and graphical representation, of the SF and BM for box-shaped vessel, on even keel, under various conditions of load.
Modern methods of determining the effect of different conditions of load and ballast on the ships structure and stability – Loadicator.
Calculations based on the foregoing and on the syllabi of the first and second years.

UNIT – IV - SHIP CONSTRUCTION
Properties of steel, aluminum and other construction materials used for shipbuilding. Effect of fire, heat, shock etc. on these materials.
Types of ships. General ideas on strength and construction. Mid ship sections of specialized carriers – Passenger ships, RoLASH, Refrigerated cargo, LNG, LPG, Chemicals etc.
An out-line knowledge of shipyard practice and procedure including drawing office methods, place and section marking, process control and prefabrication.
UNIT – V
Classification Societies and their functions. Cargo Ship Construction Rules. An outline knowledge of Tonnage Regulations.
Structural fire protection on Passenger and Cargo ships

REFERENCE BOOKS
2. Ship Construction (1988 Ed.) : Dr. J. Eyres
3. Ship Construction : Kemp and Young
7. Notes on Stability : Kemp and Young
9. Reed’s Ship Construction for Marine Students : E.A. Stokoe

SEMESTER: V ELECTIVE PAPER II
MARITIME LAW

UNIT – I
Concept of Law-Civil, Criminal Law, Public Law, public and Private International Law.
Indian contract Act with reference to following: Agreement, Offer and Acceptance, consideration, consent, capacity to contract, valid void and voidable contracts, quasi contract, breach of contract, remedies for breach, discharge of contract, agency bailment.

UNIT – II

UNIT – III
Indian Merchant Shipping Act, 1958 in general with special reference to;
   a) Definitions. Section 3.
   b) Registration of Indian Ships. Sections 20 to 74.
   c) Seamen & Apprentices. Sections 88 to 218.
   d) Limitation and Liability. Sections 352 to 352 F.
   e) Investigation and Inquires. Section 357 to 389.
UNIT – IV
Contract of affreightment:
  a) General aspects of Carriage of Goods by Sea Act, 1925.
  c) Hague Visby Rules; Hamburg Rules.
  d) Charter Party- Various Clauses and their Interpretations

UNIT – V
Marine Insurance Act- Insurable interest in a policy, difference between marine insurance policies and other policies, different types of marine insurance policies, perils of sea, claims. Settlement of claims.
Legal remedies maritime liens, at common law, general legal remedies as given in specific relief act. Writs injunction Indian Arbitration and Conciliation Act, 1996.

REFERENCE BOOKS
1. Merchant Shipping Act, 1958 : Govt. of India
2. The Indian Multimodal Transport of Goods Act, 1993 : Govt. of India
3. Carriage of Goods by Sea Act, 1925 : Govt. of India
4. Marine Insurance Act, 1963 : Govt. of India
5. The Arbitration and Conciliation Act, 1996 : Govt. of India
7. The Indian Contract Act, 1879 : I.M.O
8. Relevant Shipping Manuals, conventions & Rules : I.M.O
10. Charter Parties : MScrutton
12. Maritime Law of India : Gopalan Nair, Editor
13. Shipping Law : Charley & Giles
14. Legal Regime of Merchant Shipping : Dr. Nagendra Singh
15. Limitation of Liability of Ship-owners : Khodie Narmada
16. Maritime Liens : Dr. Thomas
17. Carriage of Goods by Sea : Mitra
19. Shipping Law : Grime R.
SEMESTER: V SKILL BASED SUBJECT
ENVIRONMENTAL SCIENCE PAPER – II

LAND-OCEAN-ATMOSPHERE INTERACTION

UNIT – I - Land:
Formation of the earth and its structure - evolution of continents and ocean basins - Continental drift hypothesis - concept of isostasy and its application to surface phenomena - Recent ideas on drift: plate tectonics - practical significance of recent information.
Materials of the earth’s crust: minerals and rocks - Rock types and their formation - Lithological characteristics and their impact on landform development - tectonic landforms: folds, faults and associated features - Volcanic and seismic activities: associated landforms.
Exogenic forces: Denudation - Weathering, mass-wasting and erosion - Marine landforms - Sea level changes - Classification of coasts.

UNIT – II - Oceans:
Major relief features of the ocean floor - Botton relief of Indian, Atlantic and Pacific oceans - Properties of ocean water: temperature, salinity and density - their vertical and horizontal distribution - Ocean currents: factors and patterns - Ocean deposits: types and their work - NIO and its activities.
Biotic resources of the oceans: fish, corals, mangroves, etc - Distribution of the biotic resources - Problems of their exploitations - environmental and other stresses - Remedial measures - Mariculture: merits and limitations.

UNIT – III
Abiotic resources: Types - Oceanic mineral nodules and placers - Oil and natural gas - Technological advances - Marine politics and law of the sea - Environmental oceanic problems and oceanic hot-spots - Future of scenario
Oceanic water as a resource: navigation, power generation, source drinking water etc. - Spatial pattern of feasibility - Oceanic islands and their strategic significance - Indian Ocean islands.

UNIT – IV - Atmosphere:
Factors affecting atmosphere motion and the resulting winds - Newton’s laws and equation of motion - Basic patterns of air movement
Horizontal and vertical distribution of atmospheric pressure and the resulting circulation - Recent advances in the knowledge of general circulation: upper air waves and jet stream - Dynamics of the Indian monsoon.

UNIT – V
Seasonal weather and climatic characteristics over India - Cyclones in Indian seas and their impact on coastal life.
Weather forecasting: methods and techniques - Constraints in accurate forecasts.
REFERENCE BOOKS:


SEMESTER: V ELECTIVE PAPER III

SHIPPING MANAGEMENT

UNIT – I - MARINE MANAGEMENT
Managing & Managers. Organization and the need for management; the management process, types of managers, management level and skills, managerial roles, the challenge of management. The evolution of management theory : Why study management theory ? The classical management theories; the behavioral school, the quantitative school – operations research and management science; the evolution of management theory.

The external environment of organization : The external environment and its importance; elements of the direct-action environment; elements of the indirect action environment; theories of total organization environments, managing the total environment.

Planning and strategic management : Planning – an overview; the formal planning process; the evolution of the concept of strategy

Social responsibility and ethics : The changing concept of social responsibilities; the shift to ethics; the tools of ethics; the challege of relativism.

Strategy implementation : Matching strategy implementation to strategy; matching structure and strategy; institutionalizing strategy.
UNIT – II
Decision making: Problem and opportunity finding; the nature of managerial decision making; the rational model of decision making; challenges to the rational model; improving the effectiveness of decision making and problem solving.
Planning and decision-making tools & techniques: The management science approach; the management science process; planning for the future – forecasting; planning for the future – scheduling; planning to meet goals with certainty; planning to meet goals with uncertainty.
Organizational structure, coordination, and design: Organizational structure; types of organizational structures, coordination, organizational design.
Authority, delegation and decentralization: Authority, Power and influence; line and staff authority; delegation; job design; decentralization.
Human resource management: The HRM process – a traditional view; human resource planning; recruitment; selection; orientation or socialization; training and development; performance appraisal; promotions, transfer, demotions, and separations; HRM and strategy.
Managing organizational change and innovation: Why planned change is needed? A model of the change process; types of planned change; organizational development; managing creativity and innovation.

UNIT – III
Motivation, performance and job satisfaction: Theories of motivation – an overview; content theories of motivation; process theories for motivation; reinforcement theory; a system view of motivation in organizations.
Leadership Defining leadership: the trait approach of leadership; the behavioral approach to leadership, contingency approaches to leadership; the future of leadership theory.
Groups and committees: Types of groups; characteristic of groups; problem solving in groups; making formal groups effective.
Communication and negotiation: The importance of communication; interpersonal communication; barriers to effective interpersonal communication; communication in organizations; using communication skills – negotiating to manage conflicts.
Effective control: The meaning of control; types of control methods; designing control systems; financial controls; budgetary control methods
Operations management: The nature of operations; the importance of operations management, designing operations systems; operational planning and control decisions; quality control.
Information systems: Information and control; management information systems; designing a computer-based MIS; implementing a computer-based MIS; end-user computing; the impact of computers and MIS on managers and organizations.

UNIT – IV – COMMERCIAL MANAGEMENT
International Trade and Shipping: Seaborne trade of the world composition and direction of cargoes – different types of ships which carry them – Technological developments – Role of Shipping on national economic development.

Tramp Trades – Chartering – different types of chartering ships – their relevance to trades – Procedures and documentation relating chartering – Charter markets of the world – How freight/charter hire is fixed.

Organization of shipping company – Manpower planning – Business and cargo management – Statutory regulations to be complied with like Foreign Exchange Regulation.

UNIT – V

Role of ports : Port locations – Functions and range services – Financial aspects of utilization and cargo handling. India’s ports, their organization and administration. Modernization and development of ports.

Role of Customs : Customs Act and documents relating to customs relating to ship operations and trade.

India Shipping Development : India’s Merchant Fleet – Role of Government –Maritime Administration in India – India’s Shipping Policy.

Maritime Frauds : Safeguards to be taken to prevent frauds with special reference to shipping industry, operators and seafaring personnel.

Role of International Organization : IMF, World Bank, IMO, UNCTAD, WTO.

REFERENCE BOOKS

1. Management : Stoner and Freeman
2. Theory and practice of Management information system : Burch, Strater, Grudnestei
3. A Concept of Corporate planning : Pussel L. and Ackoff
4. An introduction to Financial Management : Solomon and Pringle
5. Manpower Management : Dwivedi R.S.
6. Industrial Relations to India’s Developing Economy : N.N. Chattejee
7. An introduction Database System : Dale C.J.
8. Economics of Shipping and other papers : Dr. S.N. Sanklecha
9. International Maritime fraud : Ellen and Campbell
10. Elements of Shipping : Alan Branch
11. Containerisation era in India : Dr. K.V. Hariharan

SEMESTER: VI  CORE PAPER XX

PRINCIPLES OF NAVIGATION PAPER – IV

UNIT – I

The construction of the magnetic compass and binnacle. The method of determination and compensation by means of components of the effects of a ship’s magnetic field on the magnetic compass. The approximate coefficient A, B, C, D and E. Conditions which might produce coefficients A and E. Analysis of a table of deviation to obtain appropriate coefficients. Method of obtaining a table of deviations. Calculations on the above.
UNIT – II
The properties of the free gyroscope. The relationship between applied force and precession. The effect of earth’s rotation on a free gyroscope. Drift, tilt and damping. Errors associated with gyro compasses including latitude, course and speed correction, rolling error and how it is minimized. The principal parts of gyro compass, follow up and repeater systems.

UNIT – III
Hyperbolic position fixing systems : Decca Navigator : Description of the system. Errors, reliability, limitations & accuracy of the system. Loran : Description of the system. Errors, accuracy and reliability of the system.

UNIT – IV

UNIT – V

REFERENCE BOOKS:
1. Ship’s Magnetism and Magnetic Compass : F.G. Merrifield
2. Compass Work : Kemp and Young
3. Radar at Sea : G.I. Sonnenberg
6. Ships Compass : Klinkert and Grant
7. Magnetic Compass Deviation and Correction : W. Denne
8. Gyro Compass for ship’s officers : A. Frost
9. Radar observer’s handbook : W. Burger
10. Marine Electronic Navigation : S.F. Appleyard
UNIT – I - SEAMANSHIP & WATCHKEEPING

UNIT – II

UNIT – III
Life Boat/ Life raft – Statutory requirements, handling them in an emergency. Precautions in manoeuvring for launching of boats or life rafts in bad weather. Methods of taking on board survivors from lifeboats & life rafts.

Prevention of fire at sea & in port. Oxidation, flashpoint auto ignition temperature, and spontaneous combustion. Methods used to prevent the spread of fire. Action to be taken. Damage control. Action to be taken following collision and grounding.

UNIT – IV
Steps to be taken when disabled & in distress. Preservation of passengers and crew in an event emergency. Abandoning ship-survival procedure. Assisting a ship or aircraft in distress use of MERSAR manual. Management of ship in heavy weather – use of oil. Elementary ideas on Towing and being towed. Precautions to be observed to prevent pollution in port & on the high seas.

UNIT – V - MAINTENANCE
1. Inspection and maintenance of ship and equipment. Items to be covered include Hull, Bulkheads, DBs, Deep and Peek tanks, bulges, pipe lines, rudders, anchor and cables. Davits, safety equipment, derricks and other cargo gear, Navigation lights. A practical knowledge of siting and screenary of ships navigational flights.
3. Survey and classification of ships with reference to safety equipment and safety construction certificates with particular attention to maintenance aspect.

REFERENCE BOOKS

1. Theory and Practice of Seamanship : G. Danton
2. Seamanship Notes : Kemp and Young
3. Seamanship and Cargo Work : Capt. J. Dinger
4. Nicholl’s Seamanship and Nautical Knowledge : A.N. Cockroft

SEMESTER: VI    CORE PAPER XXII

VOYAGE PLANNING & COLLISION PREVENTION - PAPER III

UNIT – I - VOYAGE PLANNING

To find the time and height of HW and LW at standard ports and at secondary ports by Tidal differences. To find the time at which the tide reaches a specified height or the heights of the tide at a given time and hence the correction to be applied to soundings or charted heights of shore objects.

UNIT – II

A systematic knowledge and use of the contents of the following documents in relation to Safety of Navigation Sailing Directions
List of Light & Fog Signals
List of Radio Signals
Ocean Passages of the world
Notices to Mariners
Guide to Port Entry

UNIT – III


UNIT – IV – COLLISION PREVENTION

Thorough Knowledge of all the Rules, Annexes of International Regulations for prevention of collision and IALA buoyage systems.

UNIT – V

Radar plotting exercises
True Plot
Relative Plot
Determining bow pass distance
Revision of radar plotting syllabus done in second year
Deciding action for collision avoidance taking into consideration the ‘Rules of the Road’.
REFERENCE BOOKS
1. Chart Work : Capt. S.K. Puri
2. Rule of the Road : Bhandarkar Publications
3. BA Chart 5011 : HMSO
4. Ship Borne Radar chapters on plotting : Capt. H. Subramaniam
5. Voyage Planning and Chart Work : Capt. M.V. Naik and Capt. Varty
6. International Light, shape, sound signals : D.A. Moore
7. A Guide to collision avoidance : A.N. Cockroft
8. Chart Work : Capt. S.S. Choudhury

SEMESTER: VI  CORE PAPER XXIII
MARINE CONTROL SYSTEMS - PART III

UNIT – I – MARINE SCIENCE
1. AUXILIARIES
   a) Fuels : Different types and properties. Fuel storage & supply on board the ship
   b) Turbines : Impulse and reaction turbine, gas, turbines, steam turbine operations & care. Turbines as prime movers for various duties including as cargo pumping operations of tankers.
   c) Propeller & main shifting : Types of propellers, fixed pitched & variable pitch propellers. Pitch, pitch angle, real and apparent slip, propeller efficiency, calculations. Shifting tailend shaft, thrust block, intermediate shaft, alignment.
   e) Pollution control : Sewage disposal, methods, limits, regulations, Bilge oil water separator, regulations
2. Main propulsion units (IC engine & others)

UNIT – II
A) MAIN PROPULSION UNITS – (“IC engine”)
   c) Operations of IC engine as main propulsion engine. Warming up, starting manoeuvring, reversing and full power running of the main engine. Limitations and care required on IC engine during manoeuvring and at full power.
   d) Selection criterion of IC engines, power weight ratio, specific fuel consumption, indicated power, brake power, shaft power delivered power, thrust power, effective power. Various efficiencies, calculations. Maximum continuous rating (MCR). Calculation of fuel consumption, economic speed. Heat balance, various losses and calculations.
B) “Other propulsion units”
Steam turbine, gas turbine as main propulsion units. Advantages and disadvantages.
Manoeuvring Operations.

UNIT - III – AUTOMATION & CONTROL ENGINEERING
Introduction, growth in shipboard automation, understanding terminology. Sensors, measuring elements for temperature, pressure, level, flow, etc. Transmitter and actuators.
Automatic control systems, open loop, closed loop control system, general principles. Controllers and proportional controller. Pneumatic, hydraulic, electric, electronic control systems. Applications in various shipboard operations.
Bridge control on main propulsion. Manoeuvring aids – CP. Propeller, bow thruster. Care and precautions.

UNIT – IV
Information display, data logging, alarm systems. Testing and maintenance

UNIT – V - SAFETY ARRANGEMENTS
1. Fire detectors, smoke, heat, flame etc. Fire alarm circuits.
2. Fire Fighting systems. Fixed fire fighting installations for engine room, accommodation and cargo holds, CO2 flooding, high pressure water system, water sprinkler system, bulk dry powder and foam systems.
3. Inert gas for cargo. Inert gas production, generation from boiler fuel gas etc. Inert gas system plant. Use of O2 analyzer, explosive meter, dragger pump and other portable measuring instruments.
4. Smoke helmets, breathing apparatus, fire suit and other safety equipments.
5. Role of classification society I quality of construction, machinery and operations. Surveys and importance of same.

REFERENCE BOOKS:
1. General Engineering Knowledge for Marine Engineers by L. Jackson and T. Morton
2. Reeds Engineering Knowledge for Deck Officers by W. Embleton and T. Morton
3. Basic Electro Technology for Engineers
4. Marine Engineering Series – Marine Boilers by GTH Flanogan
5. Marine Engineering Series Diesel Engines by Wharton A.S.
6. Marine Auxiliary Machinery by D.W. Smith
7. Marine Electrical Practice by G.O. Watson
8. Instrumentation and Control for engineers
9. Firefighting equipment and its uses on ship. Marine Engineering Vol:1
SEMESTER: VI SKILL BASED SUBJECT
ENVIRONMENTAL SCIENCE PAPER - III

UNIT – I - METEOROLOGY & OCEANOGRAPHY
Air Masses and Fronts:
Air Masses :- Basic concepts, Factors governing development & properties; classification;
Convergence & Divergence Fronts :- Types; Associated weather, Frontal Depressions – Origin,
Life and movement; Forecasting Techniques. Non-frontal Depressions.
Tropical Revolving Storms : Characteristic areas & Nomenclature; Origin, Structure &
movements; associated weather; Forecasting Techniques – Past & Present; Cyclone Tracking &
warning bulletins for merchant ships under international conventions; Practical rules of
navigation for manoeuvring in the vicinity of a T.R.S.

UNIT – II
Meteorological Analysis & Weather Forecasting : Sources of Meteorological data; principles of
weather analysis; Weather forecasting; Principles & Practices, Macro, Meso & Micro level
forecasting.
Meteorological & Reporting Systems : Voluntary observing fleet under I.M.D.; type & nature of
information collected: Ship’s Weather Code; weather reporting from ships and its significance in
weather forecasting. International system of weather reporting

UNIT – III
Voyage Planning & Weather Routing of ships : Basic considerations in Voyage Planning;
selection and use of data. Weather Routing; Basic parameters; least time track and ship’s
performance curves.

UNIT – IV – ENVIRONMENTAL PROTECTION
1. Environmental Pollution: Common pollutions.
2. International convention on prevention of pollution by Marine Environment 1973/78
   (MARPOL); Pollution by oil, chemicals, hazardous substances, garbage and sewage. Pollution
by micro-organisms in ballast water; measures for prevention.

UNIT – V
Atmospheric pollution by marine transportation.
Amendments against marine pollution.
Liability against marine pollution.

REFERNCE BOOKS
1. Weather analysis & forecasting Vol. - I : S. Petterson
2. Weather analysis & forecasting Vol. - II : S. Petterson
3. Tropical Meteorology : H. Reehi
4. Principles of Meteorological Analysis : W. J. Saucier
5. Marine Meteorology : Capt. H. Subramaniam
6. Meteorology for Mariners : HMSO
9. Ship’s code : I. M. D
10. Dynamic & physical meteorology : Haltiner & Martin
11. General Meteorology : H. R. Byers
12. Numerical Weather Analysis & Predication : P. D. Thompson
13. Atlantic Hurricanes : Gerd E. Dunn
14. An Introduction to Dynamic Meteorology : J. R. Holten
15. Atmospheric science an Introduction Survey : P. E. Hobbs
16. Forecasting Manuals : I. M. D
18. Marpol 73/78 with all amendments : I. M. O.
19. Regulations for the prevention of pollution by oil : I. M. O
20. Regulations for control of pollution by Noxious substances in bulk : I.M.O
21. Shipboard oil pollution emergency plan : I. M.O

SEMESTER: VI EXTENSION ACTIVITIES / PRACTICAL III
VOYAGE PLANNING & COLLISION PREVENTION - PAPER III

VOYAGE PLANNING
Practical’s of first Year and second Year pertaining to Position fixing by various methods, current & leeway, running fix and three point bearing, and the use of hyperbolic charts, to a higher degree.
Demonstration of the ability to plan a passage taking into consideration important factors such as depth of water, distance of dangers, current, traffic separation schemes, navigations aids available etc.

COLLISION PREVENTION
The students will be required to identify various collision situations by day and by night. Practical’s to be held using a Magnetic Board, Wooden models, or any other aids to simulate such conditions.
Candidates will be required to deal with each collision situation broadly under the heading ‘recognition’, ‘responsibility’, ‘action’, ‘appropriate sound signal’ and ‘any ordinary practice of seaman’
Recognition of various buoys & marks under IALA system and appropriate actions required under the Rules.
Collision situations in restricted visibility with or without Radar Statutory obligations under both circumstances.

REFERENCE BOOKS
1. Chart Work : Capt. S.K. Puri
2. Rule of the Road : Bhandarkar Publications
3. BA Chart 5011 : HMSO
4. Ship Borne Radar chapters on plotting : Capt. H. Subramaniam
5. Voyage Planning and Chart Work : Capt. M.V. Naik and Capt. Varty
6. International Light, shape, sound signals : D.A. Moore
7. A Guide to collision avoidance : A.N. Cockroft
8. Chart Work : Capt. S.S. Choudhury