Content of 4rd Class Examinations
according to SSB 09/2017

1. Applied Mathematics:

- Simplify algebraic expressions, common factors
- Numerical calculations, significant figures
- Calculate using ratios, percentages
- Perform calculations with indices and logarithms
- Areas and centroids of regular shapes
- Trigonometric functions, their inversions, and trigonometric simple equations
- Find roots of quadratic equations
- Complex roots of equations, representing complex numbers
- Solving two simultaneous equations
- Sketching graphs of functions
- Ratios between similar areas and similar solids.

2. Applied Mechanics:

- Areas, centre of area, first and second moments of areas of regular shapes
- Centre of gravity
- Kinematics: Displacement, velocity and acceleration of a moving object
- Vector representation
- Forces, force triangle and resultants
- Equilibrium of co-planar, concurrent forces
- Moments and couples
- Reaction for simply supported beams
- Simple machines, velocity ratio, mechanical advantage, efficiency
- Dry friction, problems including friction
- Pulleys, ropes and chains
- Newton's Second Law
- Force and acceleration, linear motion, circular motion
- Energy, work and power
- Materials under load, stress, strain, modulus of elasticity, Hooke's Law
- Stress-strain relationship, elastic limit, yield stress, ultimate stress, Factor of safety
- Shear stress in beams
- Torsion of circular shafts

3. Electrotechnology:

- Simple electric circuits, current, voltage, resistance, capacitance
- Effect of temperature on resistance
- Series and parallel circuits, Wheatstone Bridge
- Electrical and mechanical units
- Ohm's Law, power
- Simple transformers
- Electrical measuring instruments
- Magnetism, magnetic fields, fields due to current
- Conductors and insulators
- Motor and generator principles
- AC and DC current, alternators and AC motors, starters
- Batteries, types, capacities
- Function and operation of switchboards

4. Thermodynamics

- SI System of Units and unit conversion
- Temperature scales, thermometers
- Calorific value of fuels, flash point

- First Law of Thermodynamics
- Enthalpy, Latent heats
- Properties of air, steam, steam tables

- Gas Laws, Universal Gas Law, Universal Gas Constant
- Specific heat of gases
- Gas processes and gas cycles

- 2-stroke and 4-stroke engines
- Calculating power, indicator diagrams, mean effective pressure
- Combustion and air-fuel ratio

- Rankine Cycle

- Specific heat capacity
- Heat transfer by Conduction, Convection, Radiation
- Insulation

- Expansion of Metals and Liquids
- Restricted thermal expansion
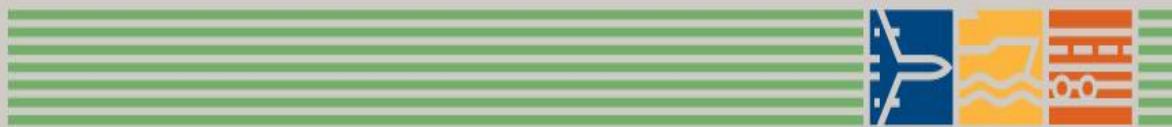
5. Naval Architecture:

I. *Ship Stability:*

Hydrostatics:
- Calculate the pressure in a liquid.
- Calculate the force and the position of the centre of pressure on immersed plane surfaces

Ship Geometry:

- Identify nomenclature used in describing ships' major parts (Bow, stern, midship, parallel middle body, midship section, deck, bottom, bilge, …)
- Identify the principal dimensions of a ship (Length between Perpendicular, Length Over All, Length of Waterline, Moulded dimensions, mean draught, freeboard, even keel, trim, mean draught)
- Calculate the ship's coefficients of ship (CB, CM, CW, CP)
- Calculate areas and their first and second moments using Simpson's 1st Rule (1-4-1) Wetted surface area
- Calculate of volumes and their centroids as applied to ships

Statical Stability – Transverse:

- Identify the forces acting on a floating or immersed bodies, Archimedes' Law, Buoyancy force, Reserve buoyancy
- Define displacement, deadweight and lightweight of a ship Calculate TPCm Immersion
- Identify load line and draught marks, Plimsoll markings
- Calculate the centre of buoyancy, centre of floatation, transverse metacentre Calculate the righting arm, righting moment
- Define stability and state the criterion for transverse stability of a ship
- Calculate the effect of adding, removing, shifting, or lifting weights on the position of the centre of gravity of a ship and on stability
- Calculate list angles and how to counteract them, increase of draught due to list Calculate the angle of loll, calculate angle of list and its correction, effect of rise of floor
- Calculate the free surface effect on the stability of a ship, means of eliminating the free surface effect
- Explain the purpose and execution of the Inclining Experiment
- Extract information from the curves of statical stability (Initial stability and range of stability, …)

Statical Stability – Longitudinal:

- Calculate the longitudinal metacentre of a ship Calculate moment causing trim MCT 1cm Calculate the position of the centre of floatation
- Effects of changes in adding, removing, shifting weights on draught and trim Calculate
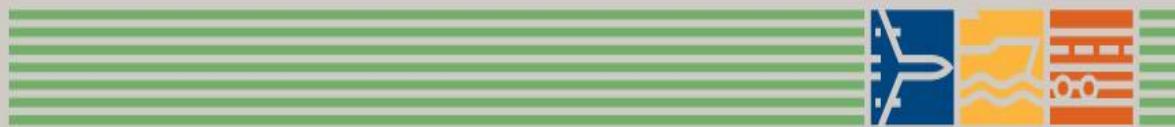
draught and trim due to transition between waters of different densities
- Calculate draughts due to flooding of a compartment in box shaped barges, permeability

II. *Ship Construction:*

- Identify ship types and their respective characteristics Identify the main structural components of the ship
- Identify the main stresses the ship is subject to (Still water bending moment, sagging and hogging, shear and bending stresses)
- Differentiate between longitudinal and transverse system of framing and their application
- Structural elements of Decks, sides, bottoms, bulkheads, stem and stern construction, hatch covers, rudders, stern tubes, watertight doors