General Engineering Science II

The candidate will know:

Heat Engines

Heat Energy
Gas Laws
Combustion
Refrigeration

Electro-Technology

Nature of Electricity
Electric Circuits
Resistance
Secondary Cells
Electromagnetic Induction
Measuring Instruments

Naval Architecture

Fluids at Rest
Transverse Stability

The candidate will be able to:

Heat Engines

Heat Energy
Defines with reference to enthalpy, sensible heat, latent heat, specific heat capacity.
Solve problems involving solids, liquids, mixtures of solids and liquids, liquids and liquids, liquids and vapours, relating to mass, specific heat capacity and temperature change.
Define, and give an example relating to marine engines of, conduction, convection and radiation.
Determine the co-efficients of linear and cubical expansion.
Solve problems relating to change of temperature and change of dimensions of solids and liquids.
Give examples, relating to marine engines, of the practical considerations relating to change of dimension due to temperature.

Gas Laws

State Charles' Law and Boyle's Law and derive the combination $\dfrac{PV}{T} = C$

Convert between Kelvin and Celsius scales of temperature, Standard Temperature and Pressure and Normal Temperature and Pressure.
Solve problems relating to pressure, volume, temperature and mass.

Combustion

States the chemical symbols of the elements and compounds associated with combustion, including the suffix and prefix numbers.
Explains higher and lower calorific values of a fuel.
Solves problems relating to the combustion of fuels by mass for stoichiometric air conditions and explains the need for excess air in relation to the effects on operation for internal combustion engines and boilers.
Defines the following:
- Indicated power;
- Brake power
- Friction power;
- Cooling water power;
- Exhaust power.

Determine Mean Effective Pressure from indicator card data.
Solves problems relative to two stroke and for stroke internal combustion engines involving indicated power, brake power, mechanical efficiency, thermal efficiency, specific fuel consumption.

Refrigeration

State the properties required of a refrigerant.
Describe a basic circuit for a compression type domestic refrigeration plant explaining the refrigerant condition at cardinal points of the circuit.

Electro-Technology

Nature of Electricity

Describe the nature of current with regard to electrons.
Explain that a current flow requires a potential difference.
Define conductor and insulator, giving three examples of each in the marine relative to ships.
Identify sources of electricity on board ships.
Identify and use preferred symbols for representation of components of electrical circuits.
Identify that an electric current has three main effects, magnetic, heating and chemical giving examples of each relative to marine vessels.

Electric Circuits

Define ampere, potential difference, electro-motive force, watt and resistance.
Solve problems using Ohm's Law for a circuit of up to three resistors in series.
Solve problems using Ohm's Law for a circuit of up to three resistors in parallel.
Solve problems relating to the power dissipated in circuits.

Resistance
States, with reference to temperature co-efficient of resistance, the effect of change of temperature on metals, carbon, electrolytes and insulation.
Solves problems relating to temperature co-efficient of resistance.
Solving problems relating to resistivity.
Explain the effect of load current on source terminal voltage.
Solve problems relating to internal resistance of a source.

Secondary Cells
Explain the difference between primary and secondary cells
Describe the chemical changes during the charging and discharging of a lead acid cell, explaining how the emf is measured in single, series and parallel configurations, state how the capacity is measured.
Given a diagram, identify the main parts of secondary cells.

Electromagnetic Induction
Define flux, flux density, mmf, and magnetising force, stating the effects of ferromagnetic materials on flux density.
Explain the motor principle in terms of the interaction between magnetic fields.
Explain the generator principle in terms of Faraday's Law and Lenz's Law.
Describe the production of an induced emf due to a change in magnetic field.

Measuring Instruments
Given a diagram, explain the principles of operation of moving iron and moving coil instruments.
Explain the need for shunts and multipliers to extend the range of a basic electrical indicating instrument

Naval Architecture

Fluids at Rest

Solve problems relating to thrust exerted due to pressure on horizontally and vertically immersed surfaces with the pressure on one side only.
Apply the Principle of Archimedes to the equilibrium of floating bodies of simple geometric form.

Transverse Stability (box shape only)

Define Centre of Gravity, Centre of Buoyancy and Metacentre.
Solve problems relating to the addition of mass to a vessel.
Solve problems involving transverse movement of masses across the deck using the equation: $GM = \dfrac{m \times d}{\Delta\Theta}$