

**FURTHER DETAILS REGARDING MAIN TOPICS OF
PROGRAMME NO. 03/2013 (Item No. 7)
ASSISTANT ENGINEER (MECHANICAL)
HARBOUR ENGINEERING & MEDICAL EDUCATION
(CATEGORY NO. 287/2010)**

1. Fluid Mechanics & Machines:

Flow through pipes- Turbulent flow through pipes, Head loss due to friction, friction factor, Mody's chart, Darcy- weisbach equation, Chezy's formula. Hydraulic Turbines : Impulse and Reaction Turbines - Pelton Wheel -Velocity triangles - Euler's equation - Speed ratio, jet ratio & work done , losses and efficiencies, design of Pelton wheel inward and outward flow reaction turbines , Francis Turbine -Positive displacement pumps- reciprocating pump - air vessels and their purposes - separation and cavitations - slip negative slip and work required and efficiency- indicator diagram- effect of acceleration and friction on indicator diagram

2. Thermodynamics:

General Thermodynamic Relations - Combined First and Second law equations - Helmholtz and Gibb's functions - Maxwell's Relations, equations for internal energy , enthalpy and entropy, ideal and real gases. Throttling process, Joule Thomson Coefficient, inversion curve. Properties of Gas Mixtures : composition of a gas mixture - Mass and Mole Fraction, Dalton's law, Gibbs - Daltons Law, equivalent molecular weight and gas constant, properties of gas mixtures -Specific Heats, Internal energy, enthalpy and Entropy

3. Metallurgy & material Science:

Equilibrium diagrams-Construction and uses-Equilibrium diagram of binary alloys: Eutectic, Eutectoid, Peritectic and peritectoid reactions. Iron-Carbon Equilibrium diagram, Isothermal TTT diagrams, Critical cooling rate. Heat treatment processes, Hardenability tests. Surface treatments, Case Hardening, Carburising, Nitriding, Cyaniding, Induction hardening. Properties, composition and uses of various types of Cast Iron and Steels - Effect of various alloying elements. Properties, composition and uses of Copper, Aluminium, Titanium and its alloys

4. Manufacturing Process:

Arc welding- Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG, MIG. Resistance welding- Spot welding, Seam welding, Projection welding, Butt welding, Flash butt welding, Percussion welding. Solid phase welding-Forge welding, friction welding, explosive welding, ultrasonic welding. Thermit welding, Atomic hydrogen welding, Electron beam welding. Types of rolling mills-Rolling of channels, I and rail sections. Rolling of tubes, wheels and axles. Defects in rolled products. Forging- open and closed die forging, press forging, roll forging, types of forging presses. Defects in forging. Extrusion-hot and cold extrusion-Wire drawing-Rotary piercing-Rotary swaging, Cold forming-thread rolling, metal spinning.

5. Thermal Engineering:

Combustion in CI and SI engines, factors affecting auto ignition, pre-ignition. Gas turbine classification, simple cycle, isentropic efficiency and mechanical efficiency, cycle efficiency and work output. Reciprocating compressor- equation for work with and without clearance volume, efficiencies. Fourier law of heat conduction- One dimensional steady state conduction with and without heat generation. Newton's law of cooling-Dimensional analysis-Buckingham's Pi theorem-Application of dimensional analysis to free and forced convection- Radiation-Nature of thermal radiation-definitions and concepts- monochromatic and total emissive power-Intensity of radiation-solid angle- absorptivity, reflectivity and transmissivity -Concept of black body- Planck' law- -Stefan Boltzmann's law.

Vapour compression systems-simple cycle - representation on T- s and P-h Diagrams. COP- Effect of operating parameters on COP — methods of improving COP of simple cycle- super heating , under cooling. Different combinations of evaporator and compressor for different applications, Cascade system Vapour absorption systems - Ammonia - water system - simple system- Lithium Bromide water system- Electrolux- comparison with vapour compression system-steam jet refrigeration.

6. Theory of Mechanism & Machines:

Mechanisms - Degrees of freedom - Kutzbach criterion - Grashof s Law - Kinematic inversions - Concepts of mechanical advantage. Transmission angle. Coupler curve. Introduction to graphical and vector approaches. Straight line mechanisms - Watt mechanism - Peaucellier mechanism - Harts mechanism. Steering mechanisms . Power transmission- Open and cross belt drive - length of belt - ratio of belt tensions - centrifugal tensions- initial tensions- V belt drive-Rope drive -Plate clutches - Conical clutches -Analysis of shoe , band , band and block brakes-internal expanding shoe brakes. Types of gears -Terminology- law of gearing - gear tooth profiles.-interference and under cutting,- calculation of minimum number of teeth, contact ratio, path of contact, arc of contact,- effect of friction in gears. Types of gear trains-compound, reverted and epicyclic. Torque in epicyclic gear trains.

7. Machine Design:

Design of spur gear, Helical gear, bevel gear and worm gear-AGMA standards. Design of I.C engine parts- cylinder, piston connecting rod, Crankshaft, Flywheel. Thread standards - stresses in screw threads, Power screw- analysis of power screws. Shaft couplings, - stresses in couplings design of couplings. Welded joints - types of welded joints - stresses in butt and fillet welds -torsion and bending in welded joints - Pressure vessels, thin cylinders, Thick cylinder equation, classification and use of springs- deflection of helical springs - design of helical springs for static and fatigue loading - design of leaf springs.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.