Syllabus for Preliminary Screening Test for recruitment to the post of Assistant Professor in Mechanical Engineering for Government Engineering & Technology Colleges under the Higher Education Department, Government of West Bengal Against Advertisement No. 4[1(Vii)]2013 & 9[1C(i)]/2013.

MECHANICAL ENGINEERING :

Paper – I **Paper – I**

Theory of Machines :

Kinematic and dynamic analysis of planer mechanism. General description and working principles of Belts, Cams, Gears and Gear trains. Inertia force analysis. Flywheels, Governors, Balancing of rotating masses and in-line engines. Linear vibration analysis of mechanical systems- single degree of freedom. Critical speeds and whirling of shafts.

Mechanics of Solids :

Simple stress and strain –plane stress and plane strain, cases, Mohr's circle. Relation of elastic constants. Stress-strain relations due to uniaxial loading. Thermal stress. Bending Moment and Shear Force diagrams of beams. Bending stress and shear stress in Bending. Deflection of beams. Torsion of circular shafts. Combined stresses-thin wall pressure vessels. Struts and columns. Strain Energy concept. Theories of failure.

Engineering Materials :

Basic concepts on structure of solids-crystalline materials. Defects in crystalline materials. Binary phase diagram for selected alloys e.g. Copper-Zinc, Copper-tin, Iron-Carbon. Ferrous alloys – structure, properties and applications. Heat treatment of steels. Plastics, Ceramics and composite materials – general character and uses.

Manufacturing Science :

Merchant force diagram. Tailors' tool life equation. Machinability. Rigid, Small and Flexible Automation. CNC concepts. Recent machining concepts—EDM, ECM,

Ultrasonic, Laser, Plasma. Introduction to Forming processes-Rolling, Forging, Extrusion. Surface finish measurement.

Manufacturing Management :

Production planning and control, Forecasting-moving average, exponential smoothing. Operations scheduling, assembly line balancing. Concept of Product development. Breakeven analysis, Capacity planning. PERT and CPM. Inventory control – ABC analysis, EOQ model. Materials Requirement Planning. Work measurement. Quality management.

Elements of Computation :

Computer Organization, Flow charting

Features of common Computer Languages – C/FORTRAN and elementary programming.

Paper – II :

1. **Thermodynamics :**

Open, closed and isolated systems.

Ideal gas law, Ideal thermodynamics processes – pdv work; Thermodynamic Cycle,

1st law and 2nd law of Thermodynamics, Concepts of Internal Energy, Entropy and Reversibility- simple problems.

Concept of Heat engine and Heat pump – efficiency and COP.

Application of 1st and 2nd laws of thermodynamics in closed and open system (SSFF Equation) – simple problems.

2. **Vapour power cycles** :- Rankine cycle and Modified Rankine cycle – simple problems
3. **Air standard cycles** : Otto, Diesel, Dual, Brayton and Bell-Colman – PV and TS diagrams, simple problems.
4. **Refrigeration** : Joule Thomson cooling effect, vapour compression cycle – simple problems.

5. **IC Engine** : a) S.I and C.I engines – basic principles of working, differences and applications, indicator diagram.

   b) 2–stroke and 4- stroke engines : working principles and simple engine performance calculations involving ηthermal, ηmechanical etc.

   c) Combustion process, Basic idea about knocking and detonation. Cetane and Octan numbers.

   d) Carburetion and Fuel injection – description only.

   e) Exhaust gas analysis : ORSAT analysis.

   f) Air – Fuel ratio – simple problems.

6. **Heat Transfer** :
   a) Fourier's law of head conduction. Derivations of unsteady 2-D heat conduction equation.
   Numerical problems involving 1-D equation. Concept of Bi-number.

b) Steady state heat conduction in extended surface – derivation of related equation and simple problems.

c) Basic concept of free and forces convections-concept and significance of Nusselt **number, Reynolds number and Grashof number.**

Simple problems with the help of empirical convection correlation for heat transfer.

d) Heat exchangers – types and use, Efficiency.
Concept of LMTD and NTU method for parallel flow and counter flow head exchangers – simple problems using LMTD method only.

e) Laws of radiation, Heat exchange between surfaces-black and non-black surfaces, View factor- simple problems.

f) Refrigeration cycles and system components, Choice of Refrigerants, Problems related **to performance, COP of refrigeration system.**

g) Airconditioning – system components and general description.Comfort indices. Cooling load calculation using psychrometric chart.

7. Fluid Mechanics:

a) Newton's law of viscosity : statement and simple problems.

b) Hydrostatic force on submerged flat plate – simple problems.

c) Flow parameter measurement – Manometer, Pitot tube, Weir, Venturi meter, Orifice meter – working principles and simple problems.

d) Application of Bernoulli's principle in simple engineering systems.

e) Head loss in pipe, Darcy – Weisbach equation, Friction factor as function of Reynolds number and relative roughness, Minor loss, Simple system head loss calculations.

f) Dimensional analysis – various dimensionless quantities, problems involving model tests and their use in prototype performance prediction.

g) Different types of pumps and their applications, Concept of specific speed, system curve and Pump performance curves – operating point.

8. Power plant :

a) Thermal and Hydraulic Power plant components – description only.

b) Different types of hydraulic and steam turbines and their areas of application.

c) Modern High pressure, high duty boilers – description.

d) I.D., F.D. and balanced draft boilers – description and simple problems, Dust removal systems – description only.

e) Heat balance, Station and plant heat rates, Plant load factor, Load curve; Station economics – simple problems.