Instructions –

(1) All Questions are Compulsory.
(2) Answer each next main Question on a new page.
(3) Illustrate your answers with neat sketches wherever necessary.
(4) Figures to the right indicate full marks.
(5) Assume suitable data, if necessary.
(6) Use of Non-programmable Electronic Pocket Calculator is permissible.
(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.
(8) Use of Steam tables, logarithmic, Mollier’s chart is permitted.

1. a) Attempt any SIX of the following: 12
   i) What is isolated system?
   ii) Define point function and path function.
   iii) State Charle’s law.
   iv) List any four boiler accessories.
   v) On P-V and T-S chart draw Isobric and Isochoric system.
vi) State any four applications of steam nozzles.

vii) State Dalton’s law of partial pressure.

viii) Define emissivity and transmissivity.

b) Attempt any TWO of the following: 08

i) Distinguish between open system and closed system and give their examples.

ii) Write steady flow energy equation and apply it to turbine and nozzle.

iii) Explain the terms ‘Heat’ and ‘Work’. Also explain why work is called ‘High grade energy’.

2. Attempt any FOUR of the following: 16

a) Differentiate between work and internal energy.

b) Explain what is PMM-I and PMM-II.

c) Prove that Kelvin Plank and Clausious statements are equivalent.

d) Draw the following gas processes on P-V and T-S diagrams-

i) Isothermal

ii) Adiabatic

e) Explain in brief Avogadro’s law.

f) A tank 2.3 m³ capacity contains air at 270°C and 0.1 MPa. Some air is drawn out of tank without changing the temperature, until pressure becomes 4kPa. Calculate mass of air left in the tank.
3. **Attempt any FOUR of the following:**

   a) Explain isothermal process.

   b) Define:
      
      i) Dry saturated steam
      
      ii) Wet steam.

   c) Draw a steam generation process at constant pressure on T-S and H-S charts.

   d) Three Kg. of steam at pressure of 3MPa exists in dry and saturated condition. Calculate following:
      
      i) Enthalpy
      
      ii) Entropy
      
      iii) Volume
      
      iv) Internal Energy

   e) Explain constant Enthalpy process.

   f) What is function of air pre-heater? State its advantages.

4. **Attempt any FOUR of the following:**

   a) Classify steam turbines.

   b) Explain what is Mach number.

   c) Explain working of Impulse turbine.

   d) With neat diagram, explain velocity compounding.

   e) Define terms related to condenser
      
      i) Vacuum efficiency
      
      ii) Condenser efficiency

   f) The vacuum in a surface condenser is 705 mm of Hg and barometer reading is 760 mm of Hg. The outlet and inlet temperature of cooling water to condenser is 38°C and 31°C respectively. Determine condenser efficiency.
5. **Attempt any TWO of the following:**

   a) i) With neat labelled diagram, explain construction and working of any one type of cooling tower.

   ii) Give sources of air leakages in the condenser. What are the effects of air leakages?

   b) With neat sketch explain construction and working of surface condenser.

   c) Give complete classification of boilers.

6. **Attempt any TWO of the following:**

   a) i) Classify heat exchangers.

   ii) Determine the rate of heat transfer through a composite wall made of 30 mm thick steel plate and covered with an insulated material of 8 mm thick on one side. Thermal conductivity of steel and insulating material is 58 W/m°k and 0.115 W/m–°k respectively. The temperature at inner and outer surfaces of wall are 280°C and 40°C respectively.

   b) i) State Fourier’s law and Stefan-Boltzman law.

   ii) State applications of heat exchangers.

   c) Draw neat labelled sketch of pipe in pipe heat exchanger and explain its construction and working.