

2125
B.E. (Mechanical Engineering)
Third Semester
MEC-301: Basic Thermodynamics

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part. Assume any missing data. Use of Steam and tables is allowed.

x-x-x

1. (a) What is a Thermodynamic system.
(b) What is a Quasi-Static Process?
(c) What is Energy Transfer?
(d) What is a PMM1?
(e) What is difference between Refrigerator & Heat Pump?
(f) What is Pure Substance?
(g) What is Internal Energy & Enthalpy?
(h) What is Steady incompressible flow?
(i) What is Kelvin-Planck statement of second law of thermodynamics?
(j) What is Heat rate? (10x1)

PART-A

2. A gas having initial pressure, volume and temperature as 275 kN/m^2 , 0.09 m^3 and 185°C respectively, is compressed at constant pressure until its temperature is 15°C . Calculate the amount of heat transferred and work done during the process. Take $R = 290 \text{ J/kg K}$ and $c_p = 1.005 \text{ kJ/kg K}$. (10)
3. (a) Draw the Mollier diagram for a pure substance. Why do isobars on Mollier diagram diverge from one another? (5)
(b) What is an incompressible substance? Describe internal energy changes and enthalpy changes for incompressible substance. (5)
4. Steam initially at 0.3 MPa , 250°C is cooled at constant volume. Find: (i) At what temperature will the steam become saturated vapour (ii) What is the quality at 80°C and, (iii) What is the heat transferred per kg of steam in cooling from 250°C to 80°C . (10)

P.T.O.

(2)

PART - B

5. (a) Steam at 1.8 MPa and 400° C steadily enters the nozzle whose inlet area is 0.02 m². The mass flow rate of steam through the nozzle is 5 kg/s. Steam leaves the nozzle at 1.4 MPa with a velocity of 275 m/s. Heat losses from the nozzle per unit mass of the steam are estimated to be 2.8 kJ/kg. Determine (i) the inlet velocity and (ii) the exit temperature of the steam. (8)
- (b) Explain the process of mass balance for steady flow processes. (2)
6. (a) What is Reversibility and Irreversibility. Explain Irreversibility due to lack of Equilibrium. (5)
- (b) A cyclic heat engine operates between a source temperature of 800° C and sink temperature of 30° C. What is the least rate of heat rejection per kW net output of the engine? (5)
7. (a) The steam consumption of a steam engine is 20 tonnes per shift of 8 hours when developing 220 kW. Dry and saturated steam enters the engine at 10 bar pressure and leaves it at 0.1 bar pressure. Estimate the Rankine efficiency and thermal efficiency of the engine. (7)
- (b) Explain the concept of Cogeneration plant. (3)

x-x-x