Mid-West University

Examinations Management Office

End-Semester Examinations -2080

Bachelor level / B.E. Computer / 2nd Semester — Full Marks: 50
Time: 3 hours — Pass Marks: 25
Subject: Thermal Science (ME421/ME503)

- *Attempt all the questions*
- *Figures in the margin indicate full marks.*
- *Assume suitable values, with a stipulation, if necessary.*
- *Candidates are required to answer the questions in their own words as far as possible.*

1. Define thermodynamic property. Differentiate between intensive and extensive properties **[1+2]**
2. Explain the differences between stored energy and transient energy with examples. Also define total energy. **[2+1]**
3. Sketch the saturation curve on p-v and T-v diagrams with all important points, lines, and region. **[2]**
4. Derive and explain first law of thermodynamics for stationary piston cylinder device. **[2]**
5. Define heat engine, refrigerator and heat pump. Also define factors used to measure their performance. **[2+2]**
6. Explain the working principle and sketch an air standard diesel cycle on P-v and T-v diagram; also derive an expression for its efficiency. **[2+1+3]**
7. Differentiate between different modes of heat transfer also define thermal resistance. **[3+1]**
8. A vertical piston–cylinder device shown in **Figure1** contains a gas at a pressure of 100 kPa. The piston has a mass of 5 kg and a diameter of 12 cm. Pressure of the gas is to be increased by placing some weights on the piston. Determine the local atmospheric pressure and the mass of the weights that will double the pressure of the gas inside the cylinder. [Take g=9.81 m/s^2] **[3]**

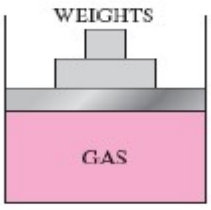

Figure1

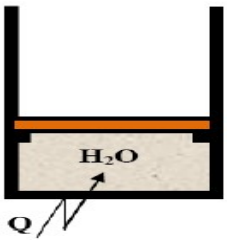

Figure2

9. A new scale N of temperature is device in such a way that the freezing point of ice is 100^0N and boiling point is 400^0N. What is the temperature reading on this new scale when the temperature is 150^0C? At what temperature, both the Celsius and new temperature scale reading would be the same? **[3]**

10. A piston cylinder device shown in **Figure2** contains 2 kg of H_2O with an initial temperature and volume of 80^0C and 0.05 m^3 respectively. It requires a pressure of 400 kPa to lift the piston from the stops. The system is heated until its temperature reaches 250^0C.Sketch the process on P-v and T-v diagrams and determine the total work transfer **[2+4]**

11. Air expands through an adiabatic turbine from 1000kPa, 1000K to 100kPa, 400K. The inlet velocity is 12m/s whereas exit velocity is 120m/s. The power output of the turbine is 3600k W. Determine the mass flow rate of air and the inlet and exit areas. [Take R=287 J/kg/K and c_p = 1005 J/kg K] **[6]**

12. An inventor makes the following claims. Determine whether the claims are valid or not and explain why or why not. **[2+2]**

a) A heat engine receives 400k J from a source at a temperature of 1000K.It rejects 150k J of heat to sink at a temperature of 300K. The engine produces 250k J of work output.

b) A heat pump can maintain a building at 20^0c when the surrounding is at 0^0c. The heat loss from room occurs at a rate of 1000k J/min and the heat pump requires 1 k W of power input.

13. A hollow cylinder with inner and outer diameters of 10cm and 14cm respectively has an inner surface temperature of 200 ^{0} C and outer surface temperature of 50 ^{0} C. If the thermal conductivity of the cylinder material is 150W/m K determine the heat transfer from the unit length of the pipe. Also determine the temperature at middle point of thickness from the axis of cylinder. **[2+2]**

The End