Mid-West University

Examinations Management Office

End-Semester Examinations -2080

Bachelor level / B.E. Civil / 2nd Semester — Full Marks: 50

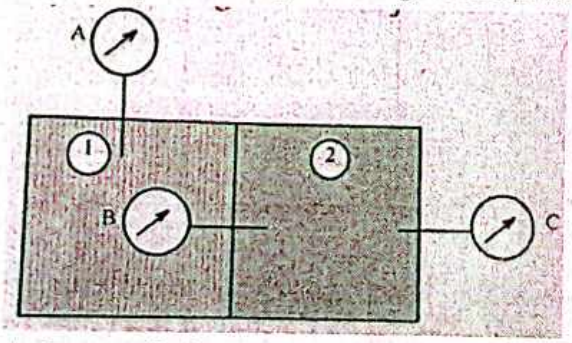
Time: 3 hours — Pass Marks: 25

Subject: Fundamental of Thermodynamics & Heat Transfer (ME422/ME104-)

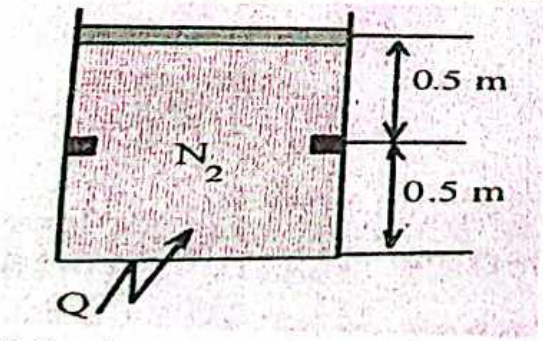
- *Attempt all the questions*
- *Figures in the margin indicate full marks.*
- *Assume suitable values, with a stipulation, if necessary.*
- *Candidates are required to answer the questions in their own words as far as possible.*

1. Explain intensive, extensive and specific property with examples. **[3]**
2. Three pressure gauge are connected to a container consisting of two compartment as shown in figure. If the local barometer reads 760 mm of Hg and pressure gauge of A and B read 200 KPa and 100 KPa respectively. Determine the absolute pressure in each compartment and reading of pressure gauge C. **[4]**

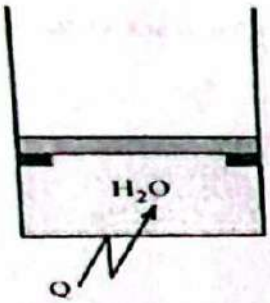
   [Take ρ_{Hg}= 13600 kg/m³ and g = 9.81 m/m²]



3. A piston cylinder devices shown in figure contains 2 kg of Nitrogen initially at a pressure of 250 KPa and a temperature of 500°C. Heat is lost from the system till it's temperature reaches 25°C. Sketch the process on P-V and T-V diagrams and determine the final pressure and the total work transfer. **[Take R= 297J/kgK]. [4]**



4. Define the quality and derive an expression for specific volume of a two phase mixture in terms of quality. **[1+3]**
5. A piston cylinder device shown in figure contains 2 kg of H_2O with an initial temperature and volume of 80°C and 0.05 m³ respectively. It requires a pressure of 400 KPa to lift the piston from the stops. The system is heated until it's temperature reaches 250°C. Sketch the process on P-V and T-V diagram and determine the total work transfer. **[4]**



6. Derive down general energy equation for a turbine and reduce it for an adiabatic turbine or compressor. [4]
7. Steam at 0.4 MPa and 200°C enters into an adiabatic nozzle with a velocity of 50 m/s and leaves the nozzle at 0.1 MPa and with a velocity of 750 m/s. Determine [4]
   a. The exit temperature of the steam.
   b. The ratio of inlet diameter to the exist diameter.
8. Explain the limitation of the first law of thermodynamic with examples. [3]
9. State Kelvin-Plank and Clausius statement of second law of thermodynamics. Also prove their equivalences. [4]
10. Explain the working principle of an ideal Brayton cycle. Sketch the cycle on P-V and T-S diagram and derive an expression for its efficiency in terms of pressure ratio. [4]
11. The compression ratio of an air standard Otto cycle is 8. At the beginning of the compression process, the pressure and temperature of air are 100 KPa and 20°C respectively. The heat added per Kg of air during the cycle is 2000KJ/Kg. Determine: [4]
    a. The pressure and temperature at the end of each process of the cycle,
    b. The thermal efficiency, and
    c. The mean effective pressure.

    [Take $\gamma = 1.4$, $c_v = 718$ J/KGK]
12. Derive an expression for steady state heat transfer through a composite hollow cylinder. [4]
13. A composite wall consists of 12 cm thick layer of common brick of thermal conductivity of 0.8 W/mK and 4 cm thick plaster of thermal conductivity of 0.5 W/mK. An insulating material of thermal conductivity 0.1 W/mK is to be added to reduce the heat transfer through wall by 65%. Determine the required thickness of the insulating layer. [4]

The End

CV – Thermal