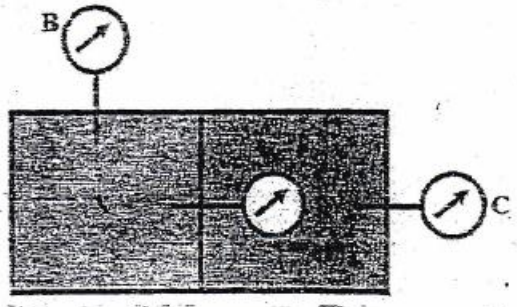
04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer *(ME402)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ ***Necessary tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Explain the difference between path function and point function with example. [4]
2. Define heat transfer and work transfer. Also mention similarities and differences between heat and work. [4]
3. Define pure substance. Explain why property tables and charts are necessary. [4]
4. Differential between steady state and unsteady state analysis. Write down general mass conservation and energy conservation equation for a steady state process and reduce them for an adiabatic turbine. [6]
5. Define isentropic process. Derive isentropic relations for an ideal gas and an incompressible substance. [6]
6. Sketch the cycle on P-v and T-s diagrams and derive an expression for its efficiency in terms of compression ratio and cut-off ratio. [6]
7. Derive expressions for inside and outside overall heat transfer co-efficient for a hollow cylinder subjected to convection medium on both sides. [6]
8. A large chamber is separated into two compartments which are maintained different pressures as shown in figure below. Pressure gauge A reads 200 kPa and pressure gauge B reads 150 kPa. If the atmospheric pressure is 100 kPa, determine the absolute pressure existing in the compartments and the reading of gauge C. [6]



9. A rigid container with a volume of 0.170 m^3 is initially filled with stream at 200 kPa, 300°C. It is cooled to 90°C. [8]
   a) At what temperature does a phase change start to occur?
   b) What is the final pressure?
   c) What mass fraction of the water is liquid in the final state?
   Also sketch the process on P-v and T-v diagrams. [Refer the attached table for properties of stream]

10. Air flows at a rate of 1.2 kg/s through a compressor, entering at 100 kPa, 25°C, wi velocity of 60 m/s and leaving at 500 kPa, 150°C, with a velocity of 120 m/s. Heat los the compressor to the surrounding is estimated to be 20 kJ/kg. Calculate the po required to drive the compressor and diameter of inlet and exhaust pipes. [Take R = J/kgK and c_p = 1005 J/kgK]

11. An air condition unit having COP 50% of the theoretical maximum maintains a house temperature of 20°C by cooling it again the surrounding temperature. The house g Energy at a rate of 0.8 KW per degree temperature difference. For a maximum work ir of 1.8 Kw, determine the maximum surrounding temperature for which it prov sufficient cooling.

12. The compression ratio of an air standard Otto cycle is 8. At the beginning of compression process, the pressure and temperature of air are 100 kPa and 2 respectively. The heat added per kg air during the cycle is 2000 kJ/kg. Determine pressure and temperature at the end of each process of the cycle, the thermal efficie and the mean effective pressure. [Take R = 287 J/kg.k and Υ = 1.4]

13. A steel pipe having an outside diameter of 2 cm is to be covered with two layer insulations, each having a thickness of 1 cm. The average conductivity of one materi 5 times that of the other. Assuming that the inner and outer surface temperature of composite insulation are fixed, calculate by what percentage the heat transfer will reduced when the better insulating materials is nearer to the pipe than it is away from pipe.

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