TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Fundamental of Thermodynamics and Heat Transfer *(ME 402)*

- ✓ 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**.*
- ✓ ***Steam tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

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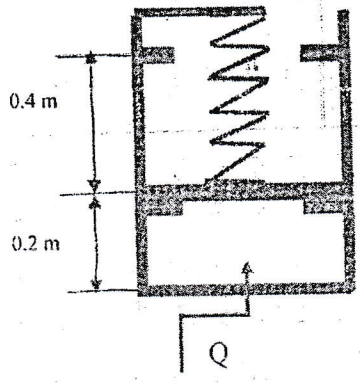
1. Differentiate between the microscopic and macroscopic view point in thermodynamic with examples. [4]
2. Differentiate between the stored energy and transient energy with examples. [4]
3. Define pure substance. Explain how saturation curve is formed on T-v diagram. [6]
4. Write down general energy equation for a heat exchanger, condenser, compressor, evaporator and throttling valve. [6]
5. Derive an expression for control mass formulation of second law of thermodynamics. [7]
6. Sketch the cycle on P-v and T-s diagrams for an ideal Diesel cycle and derive an expression for its efficiency in terms of compression ratio and cut-off ratio. [6]
7. Differentiate between steady state and unsteady state heat transfer. Derive an expression for steady state heat transfer through a composite cylinder consisting of two different materials. [6]
8. A piston cylinder arrangement with two set of stops is restrained by a linear spring (k=12 kN/m) as shown in figure below. The initial pressure of the gas is 500 kPa and the pressure required to lift the piston is 1000 kPa. Cross sectional area of the piston is 0.05 m^2. Heat is supplied to the gas until its pressure reaches 6000 kPa. Sketch the process on P-V diagram and determine the total work transfer. [8]



9. A closed rigid container with a volume of 0.2 m^3, initially contains a mixture of saturated liquid water and saturated water vapour at a pressure of 100 kPa with a quality of 40%. Heat is added to the system until its pressure reaches 200 kPa. sketch the process on P-v and T-v diagram and determine,
   a) The temperature at each state.
   b) The mass of vapour present at each state.
   c) If the heating is continued, determine the pressure at which the container holds only saturated vapour. [7]

10. Steam enters a nozzle operating at steady state with $P_1 = 10$ bar, $T_1 = 400°C$ and velocity of 10 m/s. The steam flows through the horizontal adiabatic nozzle. At the exit, $P_2 = 1.5$ bar and the velocity of 1075 m/s. The mass flow rate is 2 kg/s. Determine the exit area of the nozzle. [6]

11. 4kg of water at 25°C is mixed with 1 kg of ice at 0°C in an isolated system. Calculate the change entropy due to mixing process. [Take latent heat of ice L = 336 kj/kg, specific heat of water C = 4.18 kj/kg.k]. [6]

12. An ideal Brayton cycle has a pressure ratio of 12. The pressure and temperature at the compressor inlet are 100 kPa and 27°C respectively. The maximum temperature during the cycle 1200°C. If the mass flow rate is 8 kg/s, determine the power output and efficiency of the cycle. [Take Cp = 1.005 kj/kg.k, $\gamma = 1.4$] [7]

13. A square plate heater (10 cm × 10 cm) is inserted between two slabs having the same cross sectional areas. The left slab is 100 mm thick (k = 50 W/mK) and the right slab is 50 mm thick (k = 0.25 W/mK). The heat transfer coefficients for left and right slab outer surface are 250 W/m2K and 50 W/m2K respectively. The ambient air temperature is 25°C. If the rating of the heater is 1 kW, determine,
    a) Temperature at the heater surface
    b) Outer surface temperature of each slab [7]

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