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**Third Semester B.E. Degree Examination, July/August 2022**  
**Engineering Thermodynamics**

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

**Module-1**

- 1 a. Distinguish between macroscopic and microscopic and intensive and extensive properties. (08 Marks)  
b. Briefly explain Zeroth law of thermodynamics. (08 Marks)  
c. A 30 m high vertical column of density  $1878 \text{ kg/m}^3$  exit in a place where  $g = 9.65 \text{ m/s}^2$ . What is the pressure at base of column? (04 Marks)

**OR**

- 2 a. Explain shaft work and electric work with neat diagram. (12 Marks)  
b. With suitable example distinguish between work and heat. (08 Marks)

**Module-2**

- 3 a. Write steady state energy equations and its important applications with neat diagram:  
(i) Nozzle  
(ii) Diffuser  
(iii) Boiler (09 Marks)  
b. A stone of 20 kg mass and a tank containing 200 kg of water comprise a system. The stone is 15 m above the water level initially. The stone and water are at same temperature initially, if the stones falls into water, then determine internal energy ( $\Delta U$ ), potential energy (PE), kinetic energy (KE), heat transfer (Q) and work done (W), when :  
(i) The stone is above to enter the water  
(ii) The stone has come to rest in the tank  
(iii) The heat is transferred to the surrounding in such an amount that the stone and water come to their initial temperature. (11 Marks)

**OR**

- 4 a. With a neat sketch, explain Kelvin-Planck and Clasius statement of second law of thermodynamics. (06 Marks)  
b. Explain briefly with an examples of PMM I and PMM II. (06 Marks)  
c. A cycle heat engine operates between a sources temperature of  $1000^\circ\text{C}$  and sink temperature of  $40^\circ\text{C}$ . Find the least rate of heat injection per KW net output of engine. (08 Marks)

**Module-3**

- 5 a. Define entropy and also explain the principle of increase of entropy. (08 Marks)  
b. Explain entropy as a quantitative test for irreversibility with P-V diagram. (06 Marks)  
c. A rigid cylinder containing  $0.004 \text{ m}^3$  of nitrogen at 1 bar and 300 K is heated reversibly until temperature becomes 400 K. Determine:  
(i) The heat supplied  
(ii) The entropy change (06 Marks)

OR

- 6 a. With neat P-V diagram, distinguish between:  
 (i) Triple point and critical point  
 (ii) Sub-cooled liquid and saturated liquid  
 (iii) Saturated vapour and super heated vapour states of pure substance. (12 Marks)
- b. A closed assembly contains 2 kg of air at an initial temperature 140 kPa and 210°C respectively. If the volume of the system is doubled and temperature drops to 37°C, determine the final pressure of the air. Air can be modeled as an ideal gas. (08 Marks)

**Module-4**

- 7 a. What is refrigeration? List the types. Explain with a neat sketch of vapor absorption refrigeration system. (12 Marks)
- b. A refrigerator machine uses R-12 as the working fluid the temperature of R-12 in the evaporator coil is -5°C and the gas leaves the compressor as a dry saturated at temperature of 40°C. The mean specific heat of liquid R-12 between the above temperature is 0.963 kJ/kgK. Enthalpy of evaporation at 40°C is 203.2 kJ/kg. Neglecting the losses, find the C.O.P. (08 Marks)

OR

- 8 a. Explain briefly:  
 (i) Dry bulb temperature and wet bulb temperature  
 (ii) Summer and winter air conditioning (08 Marks)
- b. Determine the total sensible and latent cooling, required cooling 20,000 cfm of air from a temperature of 90F and a relative humidity of 60% to temperature of 55F and 100% relative humidity. (12 Marks)

**Module-5**

- 9 a. With neat sketch, explain the operation of a single stage reciprocating compressor. Write any two main differences between the single stage and multi-stage compressor. (12 Marks)
- b. Two single stage compressor work between the same pressure limits, the one having no clearance and other having a definite clearance. Prove that if they taken in equal volume, they will also discharge equal volume and the work done according to the indicator cards will be the same for both if  $n$  in  $PV^n = C$  is same for all expansion and compression curves. (08 Marks)

OR

- 10 a. Explain analysis of open cycle gas turbine with neat sketch. (06 Marks)
- b. Write advantages and disadvantages of closed cycle. (06 Marks)
- c. A Carnot engine working between 400°C and 40°C, produces 130 kJ of work, determine :  
 (i) Engine thermal efficiency  
 (ii) The heat added  
 (iii) The entropy changes during heat rejection process. (08 Marks)

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