Hall Ticket No | | | | | | | | | | | Question Paper Code: AMEC06

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech III SEMESTER END EXAMINATIONS (REGULAR/ SUPPLEMENTARY) - FEBRUARY 2024
Regulation: UG20
THERMODYNAMICS
Time: 3 Hours (MECHANICAL ENGINEERING) **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) What is a thermodynamic system? List the different types of thermodynamic systems. Explain them in detail. [BL: Understand| CO: 1|Marks: 7]

   (b) A closed system of constant volume experiences a temperature rise of 25°C when a certain process occurs. The heat transferred in the process is 30 kJ. The specific heat at constant volume for the pure substance comprising the system is 1.2 kJ/kg°C, and the system contains 2.5 kg of this substance. Determine:

   i) Change in internal energy

   ii) Work done. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Write the limitations of first law of thermodynamics. State the laws of thermodynamics for

   i) Clausius statement

   ii) Kelvin-Planck statement. [BL: Understand| CO: 2|Marks: 7]

   (b) Find the co-efficient of performance and heat transfer rate in the condenser of a refrigerator in kJ/h which has a refrigeration capacity of 12000 kJ/h when power input is 0.75 kW. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Outline about pure substance. Draw and explain a P - T (pressure-temperature) diagram for a pure substance. [BL: Understand| CO: 3|Marks: 7]

   (b) A vessel having a capacity of 0.05 m3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Find the following

   i) Pressure

   ii) Mass

   iii) Specific volume

   iv) Specific enthalpy

   v) Specific entropy

   vi) Specific internal energy. [BL: Apply| CO: 3|Marks: 7]

4. (a) State Vander Waals equation. Explain, how the heat and work transfer observed in perfect gas? [BL: Understand| CO: 4|Marks: 7]

   (b) 0.5 kg of air is compressed reversibly and adiabatically from 80 kPa, 60°C to 0.4 MPa, and is then expanded at constant pressure to the original volume. Sketch these processes on the P - V and T - S planes. Compute the heat transfer and work transfer for the whole path. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Outline the concept of dew point temperature. Compare dry bulb temperature and wet bulb temperature with a sketch. [BL: Understand| CO: 5|Marks: 7]

   (b) A vessel of 0.35 m^3 capacity contains 0.4 kg of carbon monoxide (molecular weight = 28) and 1 kg of air at 20°C. Calculate:

   i) Partial pressure of each constituent

   ii) Total pressure in the vessel, and the gravimetric analysis of air is to be taken as 23.3% oxygen (molecular weight = 32) and 76.7% nitrogen (molecular weight = 28). [BL: Apply| CO: 5|Marks: 7].

6. (a) Summarize Avogadro's laws of additive volumes. Compare volumetric and gravimetric analysis of mixtures. [BL: Understand| CO: 5|Marks: 7]

   (b) The atmospheric conditions are; 20°C and specific humidity of 0.0095 kg/kg of dry air. Calculate the following:

   i) Partial pressure of vapour

   ii) Relative humidity

   iii) Dew point temperature. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Explain in details the dual cycle and its processes in detail using P - V and T - S diagram. [BL: Understand| CO: 5|Marks: 7]

   (b) An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m^3. The initial pressure and temperature are 1 bar and 50°C. If the maximum pressure is limited to 25 bar, find the following:

   i) The air standard efficiency of the cycle.

   ii) The mean effective pressure for the cycle. Assume the ideal conditions. [BL: Apply| CO: 5|Marks: 7].

8. (a) Compare Otto, Diesel and Dual combustion cycles with following variable factors:

   i) Compression ratio

   ii) Maximum pressure

   iii) Network done [BL: Understand| CO: 5|Marks: 7]

   (b) The minimum pressure and temperature in an Otto cycle are 100 kPa and 27°C. The amount of heat added to the air per cycle is 1500 kJ/kg.

   i) Determine the pressures and temperatures at all points of the air standard Otto cycle.

   ii) Also calculate the specific work and thermal efficiency of the cycle for a compression ratio of 8 : 1. Take for air : $C_v = 0.72$ kJ/kg K, and $\gamma = 1.4$. [BL: Apply| CO: 5|Marks: 7]

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