Hall Ticket No | | | | | | | | | | | Question Paper Code: AAEC02

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech III SEMESTER END EXAMINATIONS (REGULAR/ SUPPLEMENTARY) - FEBRUARY 2024
Regulation: UG20

ENGINEERING THERMODYNAMICS

Time: 3 Hours **(AERONAUTICAL 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 and 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 atconstant volume for the puresubstance comprising the system is 1.2 kJ/kg°C, and the systemcontains 2.5 kg of this substance. Determine

   i) The change in internal energy

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

MODULE – II

2. (a) Write the limitations of first law of thermodynamics. State the law 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 m^3 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) Describe the process of formation of steam and give its graphical representation. [BL: Understand| CO: 4|Marks: 7]

(b) A quantity of steam at 10 bar and 0.85 dryness occupies 0.15 m^3. Determine the heat supplied to raise the temperature of the steam to 300°C at constant pressure and percentage of this heat which appears as external work. Take specific heat of superheated steam as 2.2 kJ/kg K.

[BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Explain in detail about the dual cycle and its processes using PV and TS 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].

6. (a) Compare Otto, diesel and dual combustion cycles with following variable factors:

i) Compression ratio

ii) Maximum pressure

iii) Network [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 : cv = 0.72 kJ/kg K, and $\gamma = 1.4$. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Classify the heat exchangers and explain shell and tube heat exchanger in detail with a neat sketch. [BL: Understand| CO: 6|Marks: 7]

(b) A mild steel tank of wall thickness 12 mm contains water at 95°C. The thermal conductivity of mild steel is 50 W/m°C, and the heat transfer coefficients for the inside and outside the tank are 2850 and 10 W/m^2°C, respectively. If the atmospheric temperature is 15°C, calculate

i) The rate of heat loss per m^2 of the tank surface area

ii) The temperature of the outside surface of the tank. [BL: Apply| CO: 6|Marks: 7]

8. (a) List varoius air compressors and explain the operation principle of reciprocating air compressor in details with its sketch. [BL: Understand| CO: 6|Marks: 7]

(b) The interior of a refrigerator having inside dimensions of 0.5 m × 0.5 m base area and 1 m height, is to be maintained at 6°C. The walls of the refrigerator are constructed using two mild steel sheets having thickness of 3 mm (k = 46.5 W/m°C) with 50 mm of glass wool insulation (k =0.046 W/m°C) between them. If the average heat transfer coefficients at the inner and outer surfaces are 11.6 W/m^2°C and 14.5 W/m^2°C respectively, calculate :

i) The rate at which heat must be removed from the interior to maintain the specified temperature in the kitchen at 25°C

ii) The temperature on the outer surface of the metal sheet. [BL: Apply| CO: 6|Marks: 7]

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