Hall Ticket No | | | | | | | | | | | Question Paper Code: AME003

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech III Semester End Examinations (Supplementary) - July, 2018

Regulation: IARE – R16

THERMODYNAMICS

Time: 3 Hours **(ME)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Explain Quasi static process with neat sketch. **[7M]**

   (b) A fluid, contained in a horizontal cylinder fitted with a frictionless leak proof piston, is continuously agitated by means of a stirrer passing through the cylinder cover. The cylinder diameter is 0.40 m. During the stirring process lasting 10 minutes, the piston slowly moves out a distance of 0.485 m against the atmosphere. The net work done by the fluid during the process is 2 kJ. The speed of the electric motor driving the stirrer is 840 rpm. Determine the torque in the shaft and the power output of the motor. **[7M]**

2. (a) Explain the following **[7M]**
   i. Constant volume gas thermometer
   ii. Zeroth law of thermodynamics

   (b) A gas undergoes a thermodynamic cycle consisting of the following process **[7M]**
   i. Process 1-2: constant pressure, P_1=1.4bar, V_1=0.028 m^3, W_{1-2}=10.5KJ
   ii. Process 2-3: compression with PV=C, U_3=U_2
   iii. Process 3-1: constant volume U_1=U_3 = -26.4KJ. There are no significant change in KE and PE. Sketch the cycle on a PV diagram and prove that $\sum Q_{cycle} = \sum W_{cycle}$

UNIT – II

3. (a) What are the limitations of first law of thermodynamics? **[7M]**

   (b) A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60^0C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C. The reversible heat engine also drives a machine that absorbs 30 kW. If the heat pump extracts 17 kJ/s from the 5^0C reservoir, determine **[7M]**
   i. The rate of heat supply from the 840°C source
   ii. The rate of heat rejection to the 60°C sink.

4. (a) Derive Maxwell's relations from thermodynamic relations **[7M]**

   (b) One kg of ice at -10^0C is exposed to the atmosphere which is at 20^0C. The ice melts and comes into thermal equilibrium with the atmosphere. Determine the entropy increase of the universe. Take specific heat for ice 2.0982kJ/kgK and latent heat of fusion 333.3kJ/kg. **[7M]**

UNIT – III

5. (a) With a neat sketch explain Throttling Calorimeter. **[7M]**

   (b) Ten kg of water at 45^0C is heated at constant pressure of 10 bar until it become superheated vapor at 300^0C. Find the changes in volume, enthalpy, internal energy and entropy. **[7M]**

6. (a) Explain triple point and critical point with respect to pressure temperature [PT] plot. **[7M]**

   (b) A rigid vessel of volume 0.86 m^3 contains 1 kg of steam at a pressure of 2 bar. Evaluate the specific volume, temperature, dryness fraction, internal energy, enthalpy and entropy of steam. **[7M]**

UNIT – IV

7. (a) State and prove the Gibbs theorem. **[7M]**

   (b) A gaseous mixture consists of 1kg of oxygen and 2kg of nitrogen at a pressure of 150kPa and a temperature of 20^0C. Determine **[7M]**

      i. Mole fraction of each constitute
      ii. The equivalent molecular weight of the mixture
      iii. The equivalent gas constant of the mixture
      iv. The partial pressure and volumes
      v. The c_p and c_v of the mixture

8. (a) Define below terms **[7M]**

      i. Dry bulb temperature
      ii. Wet bulb temperature
      iii. Specific humidity
      iv. Relative humidity

   (b) The reading from sling psychrometer as follows, Dry bulb temperature = 30^0C, Wet bulb temperature = 20^0C and barometer reading = 740 mm of Hg. Using steam table determine, Dew point temperature, Relative humidity, Specific humidity and Degree of saturation. **[7M]**

UNIT – V

9. (a) Explain with PV and T s plot for same compression ratio and heat rejection, which cycle is highest efficiency (Otto, Diesel and Dual cycle) **[7M]**

   (b) In an air standered Otto cycle the compression ratio is 7, and compression begins at 35^0C, 0.1MPa. The maximum temperature of the cycle is 1100^0C. Find **[7M]**

      i. The work done per kg of air
      ii. The cycle efficiency
      iii. The mean effective pressure of the cycle.

10. (a) Explain Bell- Coleman cycle with PV and T s diagram. **[7M]**

    (b) A diesel engine has a compression ratio of 14 and cutoff takes place at 6% of the stroke. Find air standard efficiency. **[7M]**

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