CBCS Scheme

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15AE33

Third Semester B.E. Degree Examination, June/July 2018
Aero Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer any FIVE full questions, choosing one full question from each module.***
2. ***Use of Thermodynamics data handbook is permitted.***

Module-1

1 a. Distinguish between : i) Intensive and Extensive properties ii) Diathermal and Adiabatic wall. **(04 Marks)**

b. State Zeroth law of thermodynamics and extract the concept of temperature from it. **(06 Marks)**

c. The temperature T on a thermometric scale is defined as $T = a \ln k + b$, where a and b are constants. The values of k are found to be 1.83 and 6.78 at 0^0 C and 100^0 C respectively. Calculate the temperature for a value of K = 2.42. **(06 Marks)**

OR

2 a. Bring out two similarities and two dissimilarities between heat and work. **(04 Marks)**

b. Derive an expression for displacement work in a polytropic process pV^n = constant. Show on a p-v diagram four expansion processes for n = 0 , n = 1 , n = 1.4 and n = ∞. Name each of the process. **(08 Marks)**

c. A shaft transmitting 600 hp rotates at 3600 rpm. Determine the torque applied to the shaft. **(04 Marks)**

Module-2

3 a. Write the first law of thermodynamics for any process in :
i) closed system ii) Open system. **(04 Marks)**

b. A stationary mass of gas is compressed without friction from initial state of $0.3m^3$ and 0.105 MPa to a final state of $0.15m^3$ and 0.105MPa, the pressure remaining constant during the process. There is a transfer of 37.6kJ of heat from the gas during the process. How much does the internal energy of the gas change? **(06 Marks)**

c. A domestic refrigerator is loaded with food and the door closed. During a certain period of time the machine consumes 1kWh of energy and the energy of the system decreases by 5000 kJ. Determine the magnitude and direction of heat transfer for the process. **(06 Marks)**

OR

4 a. Write Steady Flow Energy Equation and explain all the terms involved. **(04 Marks)**

b. Apply SFEE for : i) Adiabatic Nozzle ii) Steam turbine. **(06 Marks)**

c. A small turbine runs an aircraft refrigeration system. Air enters the turbine at 4 bar and 40^0 C with velocity 200m/s. If the work output of the turbine is 52kJ/kg of air, calculate the heat transferred per kg of air. **(06 Marks)**

Module-3

5 a. Represent schematically and give performance equation for : **(04 Marks)**
i) Heat engine ii) Refrigerator iii) Heat pump.
Prove that $(COP)_{HP} = (COP)_{Refrigerator} + 1$.

b. State Kelvin Planck and Clausius statements of second law of thermodynamics and show that they are equivalent. **(06 Marks)**

c. A reversible refrigerator operates between 35^0C and -15^0C. If heat rejected to 35^0C is 1.5kw, determine the rate at which heat is leaking into refrigerator. **(06 Marks)**

OR

6 a. Define Entropy and prove that it is a property of the system. **(04 Marks)**

b. For an ideal gas undergoing finite change of state from 1 to 2, derive an expression for change in entropy. **(05 Marks)**

c. A block of iron weighing 100kg and having a temperature of 100^0C is immersed in 50kg of water at a temperature of 20^0C. What will be the change in entropy of the combined system of iron and water? Specific heats of iron and water are 0.4kJ/kg K and 4.18 kJ/kg K respectively. **(07 Marks)**

Module-4

7 a. Define : i) Pure substance ii) Saturation conditions iii) Triple point iv) Critical point v) Compressibility factors. **(05 Marks)**

b. Sketch and explain P – T diagram of water. **(05 Marks)**

c. Find enthalpy, entropy and volume of steam at 1.4MPa and 380^0C. **(06 Marks)**

OR

8 a. Derive and explain Maxwell's equations. **(08 Marks)**

b. Show that for an ideal gas $C_p - C_v = R$. **(02 Marks)**

c. 1 kg of air at a pressure of 8 bar and temperature 100^0C undergoes reversible polytropic process following the law $pv^{1.2}$ = constant. If final pressure is 1.8 bar determine the final specific volume, Temperature and increase in entropy. Assume R = 0.287 kJ/kg k , r = 1.4. **(06 Marks)**

Module-5

9 a. What are Air standard Assumptions? **(04 Marks)**

b. Explain Working of a diesel engine with the help of p –v and T-S diagrams. Derive an expression for the efficiency of diesel cycle in terms of its compression and cut – off ratios. **(07 Marks)**

c. A diesel engine has a compression ratio of 14 and cut – off takes place at 6% of stroke. Find Air -- standard efficiency. **(05 Marks)**

OR

10 a. Explain Rankine cycle with the help of a sketch and T – S diagram. Derive an expression for thermal efficiency of Ranking cycle. **(06 Marks)**

b. What are the methods for increasing the efficiency of Rankine cycle? **(04 Marks)**

c. Consider a steam power plant operating on a simple Ranking cycle. Steam enters the turbine at 3MPa and 350^0C and is condensed in the condenser at a pressure of 75KPa. Determine the thermal efficiency of the cycle. **(06 Marks)**

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