CBCS Scheme

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15AU33

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Distinguish between :
i) Macroscopic and microscopic approach.
ii) Intensive and Extensive properties
iii) Closed and open system.
iv) Work and Heat **(08 Marks)**

b. A mass of gas is compressed in a quasistatic process from 80KPA : $0.1m^3$ to 0.4MPa ; $0.025m^3$. Assuming that the pressure and volume are related by $PV^n = C$. Find the work interaction during the process. Is it work producing system or work absorbing system? **(08 Marks)**

OR

2 a. With a neat PV diagram, derive an expression for work done in i) Isothermal process ii) Isobaric process iii) Polytropic process. **(08 Marks)**

b. Two Celsius thermometer A and B agree at ice point and steam point and are related by equation $t_A = L + Mt_B + N(t_B)^2$, where L, M and N are constants. When both thermometers are immersed in fluid. A registers 26°C while B registers 25°C. Determine the reading of A when B reads 35°C. **(08 Marks)**

Module-2

3 a. Represent schematically heat engine, heat pump and refrigerator. Give their performance. **(06 Marks)**

b. What are PMM – I and PMM – II? **(04 Marks)**

c. At the inlet to a certain nozzle the enthalpy of the fluid passing is 3000kJ/kg and the velocity is 60m/s. At discharge and the enthalpy is 2762 kJ/kg the nozzle is horizontal and there negligible heat loss from it.
i) Find the velocity at the exit from the nozzle
ii) If the inlet area is $0.1m^2$ and specific volume at inlet is $0.187m^3/kg$, find the mass flow rate.
iii) If the specific volume at the nozzle exit is 0.498 m^3/kg, find the exit area of the nozzle. **(06 Marks)**

OR

4 a. State :
i) I law of thermodynamic as applied to a closed system
ii) Kelvin planck **(06 Marks)**
iii) Claussius **(04 Marks)**

b. Define : i) Available energy ii) Unavailable energy

c. A reversible heat engine operates with two environments. In the first it draws 12000kW form a source at 400°C in the second it draws 25000kW a source at 100°C. In both the operations. The engine rejects heat to a thermal sink at 20°C. Determine the operation in which the engine delivers more power. **(06 Marks)**

Module-3

5 a. Define the following :
   i) Stoichiometric air
   ii) Enthalpy of combustion. **(04 Marks)**

b. Derive the expression for air standard efficiency cycle with usual notations represent the process on PV and T-S diagram. **(08 Marks)**

c. In a test of four cylinder, four stroke engine 75mm bore and 100mm stroke the following results were obtained at full throttle at a particular constant speed and with fixed setting of fuel supply of 6 kg/hr

B.P with all cylinder working	=	15.6 kW
B.P with cylinder 1 cut out	=	11.1 kW
B.P with cylinder 2 cut out	=	11.03 kW
B.P with cylinder 3 cut out	=	10.88 kW
B.P with cylinder 4 cut out	=	10.66 kW

If C.V of Fuel = 83600kJ/kg and clearance volume = $0.0001m^3$. Calculate
   i) Mechanical efficiency
   ii) Indicated thermal efficiency **(04 Marks)**

OR

6 a. With neat sketch explain the analysis of exhaust gasses by Orsat apparatus. **(06Marks)**

b. For the same compression ratio which cycle is more efficient, Otto, Disel or Dual? Explain with PV and T-S diagram. **(06 Marks)**

c. During the trial of a single cylinder four stroke oil engine the following results were obtained cylinder dia = 20cm, stroke = 40cm, IMEP = 6bar, Torque = 407 N-m, Speed = 250rpm, Oil consumption = 4 kg/hr CV of oil = 43000kJ/kg, Cooling water flow rate = 4.5 kg./min, A:F = 30:1, Rise in cooling water temperature = 45°C, Temperature of exhaust gases = 420°C, Room temp = 20°C, C_{pg} = 1kJ/kg K, C_{pw} = 4.18 kJ/kg-K, Draw heat balance for the test in kW and in percent. **(04 Marks)**

Module-4

7 a. What are the desirable properties of good refrigerants? **(05 Marks)**

b. With neat sketch describe winter air conditioning system. **(06 Marks)**

c. In a room, the dry and wet bulb thermometers read 35°C and 25°C and the barometer reading is 760mm hg. Using tables calculate the specific humidity, relative humidity and enthalpy of air per kg of dry air. **(05 Marks)**

OR

8 a. Define the following :
   i) Refrigerating effect
   ii) COP
   iii) Ton of refrigeration
   iv) Dry bulb temperature (DBT)
   v) Wet bulb temperature (WBT) **(05 Marks)**

   b. Explain the following Psychrometric process
   i) Sensible heating
   ii) Sensible cooling
   iii) Humidification **(06 Marks)**

   c. 2kW per ton of refrigeration is required to maintain the temperature of 45°C in the refrigerator. If the refrigerator works on Carnot cycle. Determine: i) COP of the cycle ii) Temperature of sink. **(05 Marks)**

Module-5

9 a. With a neat sketch explain :
   i) Turbo – jet engine
   ii) Rocket propultion **(08 Marks)**

   b. Derive an expression for work done in a single stage compressor Neglecting clearance. **(08 Marks)**

OR

10 a. Derive the expression for Brayton cycle of optimum pressure ratio for maximum specific power output interms of maximum and minimum temperature of the cycle. **(08 Marks)**

   b. A two stage air compressor with perfect inters cooling takes in air at 1bar and 27°C. The law of compression in both stages is $PV^{1.3} = C$. the compressed air is delivered at 9 bar calculate for unit mass flow rate of air the minimum work done and the heat rejected in the inter cooler. Compare the values if compression is carried out in single stage compression. **(08 Marks)**

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