CBCS SCHEME

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15AU33

Third Semester B.E. Degree Examination, Aug./Sept.2020
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 TD Data handbook, Steam tables, Psychrometric chart allowed.***

Module-1

1 a. Define the following : i) Thermodynamic equilibrium ii) Quasistatic process. **(04 Marks)**

b. Distinguish between :
i) Intensive and Extensive Properties ii) Open system and Closed system.
iii) Microscopic and Macroscopic point of approach. **(06 Marks)**

c. A certain thermometer using pressure as thermometric property gives values of pressure P = 1.86 and 6.81 at ice point and steam point respectively. If ice point and steam point are assigned the numbers 10 and 120 respectively, determine the temperature corresponding to P = 2.3. The temperature and pressure are related by equation $t = a\ell np + b$. **(06 Marks)**

OR

2 a. Show that Thermodynamics definition of work is superior to mechanics definition of work. **(05 Marks)**

b. Write sign convention for work and heat. **(04 Marks)**

c. A cylinder contains 1 kg of certain fluid at an initial pressure of 20 bars. The fluid is allowed to expand reversibly behind a piston according to PV^2 = const until the volume is doubled. The fluid is then cooled reversibly at constant pressure until is regains its original volume. Heat is then supplied at constant volume till pressure rises to original value. The initial volume is $0.05m^3$. Calculate network and draw PV diagram. **(07 Marks)**

Module-2

3 a. Explain Joules Paddle wheel experiment, with neat sketch. **(05 Marks)**

b. A steam turbine operating under steady flow condition receives 4500 kg of steam per hour. The steam enters the turbine at a velocity of 2500m/min and at an elevation of 4m and a specific enthalpy of 2785 kJ/kg. It leaves the turbine at a velocity of 560m/min and elevation of 1m and specific enthalpy of 2262 kJ/kg. The heal loss from the turbine to surrounding amounts to 16750 kJ/hr. Determine power output of the machine. **(08 Marks)**

c. Apply steady flow energy equation to adiabatic Nozzle. **(03 Marks)**

OR

4 a. Prove that Kelvin Plank statement and Clausius statement are equivalent. **(08 Marks)**

b. Define PMM I and PMM II kind devices. **(03 Marks)**

c. A heat engine absorbs 200 kJ/S of heat at 227^0C and reject heat at 27^0C. There are three separate cases of heat rejection are reported.
i) 180 kJ/s of heat is rejected ii) 120 kJ/s of heat is rejected
iii) 60 kJ/s of heat is rejected. Classify the cycles. **(05 Marks)**

Module-3

5 a. Define the following : i) Stoichiometric Air ii) Excess Air iii) Actual Air. **(06 Marks)**

b. Show that efficiency of otto cycle is given by

$$\eta = 1 - \frac{1}{R_C^{r-1}}$$ and draw PV and TS diagram. **(10 Marks)**

OR

6 a. Define the following : i) Brake power ii) Indicated power iii) Indicated Thermal efficiency iv) Brake Thermal efficiency. **(08 Marks)**

b. A 4 stroke , 4 cylinder petrol engine was tested at full throttle speed. The following were the power measuring during Mohr's test :
i) BP (Brake Power) with all cylinders working = 14.7 kW.
ii) BP with 1st cylinder cut off = 10.1 kW iii) BP with 2nd cylinder cut off = 10.3 kW
iv) BP with 3rd cylinder cut off = 10.2 kW iv) BP with 4th cylinder cut off = 10.4 kW.
Calculate IP, BP and FP of the engine. **(08 Marks)**

Module-4

7 a. Define the following : i) Refrigeration effect ii) Ton of Refrigeration iii) Coefficient of performance iv) Latent Heat. **(08 Marks)**

b. An NH_3 refrigerator operates between evaporating and condensing temperature of -16^0C and 50^0C respectively. The vapour is dry saturated at the compressor inlet. The compression process is isentropic and there is no under cooling of the condensate. Calculate
i) Refrigeration effect in KJ/kg.
ii) Mass flow rate and Power input per ton or refrigeration.
iii) COP.
Take Cp for vapour refrigerant 3.3 KJ/kg K. **(08 Marks)**

OR

8 a. Define the following : i) Dry Bulb temperature ii) Wet Bulb temperature iii) Specific humidity iv) Relative humidity. **(08 Marks)**

b. Explain Summer air conditioning for hot and Humid outdoor conditions, with neat sketch. **(08 Marks)**

Module-5

9 a. Derive expression for work done in two stage compressor with perfect inter cooling express intermediate pressure in terms of maximum and minimum pressure for minimum work done. **(08 Marks)**

b. Classify gas turbines. **(06 Marks)**

c. Define Volumetric efficiency for reciprocating air compressor. **(02 Marks)**

OR

10 a. For Bryaton cycle show that

$$\eta = 1 - \frac{1}{R_p^{(\gamma-1)/\gamma}}$$ **(06 Marks)**

b. Write a note on : i) Jet propulsion ii) Rocket propulsion. **(05 Marks)**

c. Air enters the compressor of a gas turbine plant operating on Bryaton cycle at 101.32 Kpa and at 27^0C and the pressure ratio in the cycle is 6. If the turbine work = 2.5 times the compressor work, determine the maximum temperature in the cycle and efficiency of the cycle. **(05 Marks)**

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