CBCS SCHEME

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15AU33

Third Semester B.E. Degree Examination, June/July 2019
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 Steam table and Psychrometry chart is permitted.***

Module-1

1 a. Explain Mechanical , Chemical and Thermal Equilibrium. **(06 Marks)**

b. State and explain Zeroth law of thermodynamics. **(06 Marks)**

c. With suitable examples, distinguish between :
i) Closed and Open System ii) Intensive and Extensive properties. **(04 Marks)**

OR

2 a. Derive an expression for work done during Quasi static process. Explain its significance with the help of P-V diagram. **(05 Marks)**

b. What are the similarities and dissimilarities between heat and work? **(05 Marks)**

c. The readings t_A and t_B of two Celsius thermometers A and B agrees at ice and steam point, but elsewhere are related by the equation $t_A = L + Mt_B + Nt_B^2$, where L, M, N are constants, when both thermometers are immersed in a system of fluid, A registers 11^0C while B registers 10^0C. Determine the readings on A when B registers 37.4^0C. **(06 Marks)**

Module-2

3 a. Describe the classic paddle wheel experiment performed by Joule. What conclusion was drawn based on the experimental observations. **(08 Marks)**

b. A fluid system undergoes processes a-b, b-c, c-d and d-a to complete a cycle. During one cycle, the total negative heat transfer is 84kJ. The system completes 100 cycles per minute. The energy transfers are tabulated below.

Process	d_q (kJ/min)	d_w (kJ/min)	d_u (kJ/min)
a → b	0	-20945	?
b → c	20945	0	?
c → d	2094	?	37700
d → a	?	?	?

Complete the table showing your method of calculation for each item. **(08 Marks)**

OR

4 a. Write two statements of Second law of thermodynamics and establish equivalence of Kelvin – Plank and Clausius statements. **(08 Marks)**

b. 2 kg of air at 10 bar absolute pressure and 600^0C temperature expands isothermally to 5 times its original volume. Calculate the following :
i) The original volume ii) The final pressure iii) The change in entropy. **(08 Marks)**

Module-3

5 a. Derive the expression for the air standard efficiency of a otto cycle with usual notations. State the assumptions made and represent the process of P – V and T – S diagram. **(08 Marks)**

b. A single cylinder four stroke oil engine working on Dual combustion cycle has a compression ratio of 15:1. The engine draws in air at 1 bar and 27^0C and the maximum pressure in the cylinder is limited to 55 bars. If the heat transfer at constant volume is twice that at constant pressure. Determine i) The constant volume pressure ratio
ii) Cut off ratio iii) The thermal efficiency of the cycle. **(08 Marks)**

OR

6 a. Describe the following as applied to I.C. engines :
i) Morse Test ii) Willan's line method. **(08 Marks)**

b. A test on a single cylinder 4 stroke oil engine having bore = 18cm and stroke = 36cm yielded the following results : Speed = 285 rpm , Brake torque = 0.14 kNm , Indicated MEP = 7.2 bar , Fuel consumption = 3.5 kg/hr , Cooling water flow = 4.5kg/min Cooling water temperature rise = 36^0C , A/F ratio = 25 , Exhaust gas temperature = 415^0C Room temperature = 21^0C , Barometric pressure = 1 bar , Calorific value = 45220 kJ/kg. Determine i) Brake power ii) Indicated power iii) Indicated thermal efficiency. Draw up a heat balance sheet on minute and percentage basis. **(08 Marks)**

Module-4

7 a. With neat sketches, explain vapour compression refrigeration system and also draw the T – S and p – h diagrams. **(08 Marks)**

b. In a vapour absorption system, the operating temperatures of generator , condenser and evaporator are 300^0C , 25^0C and -10^0C respectively. Determine the theoretical C.O.P. It is required to produce 20 tons of ice from water at 20^0C to ice at -5^0C. Find the capacity of the heating coil. Take actual C.O.P as 85% of theoretical. Take, C_p for ice = 2.1 kJ/kg k ; C_p for water = 4.19 kJ/kg K and Enthalpy of fusion of ice = 336 kJ/kg. **(08 Marks)**

OR

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

b. Moist air at 35^0C has a dew point of 15^0C. Calculate its Relative humidity. Specific humidity and Enthalpy. Take C_{PV} = 1.88 kJ/kg ^{0}K. **(08 Marks)**

Module-5

9 a. Derive the condition for minimum work input to a two stage compressor with perfect inter – cooling in between stages. Extending this to a multi stage compressor with perfect inter – cooling in between stages. **(08 Marks)**

b. A two stage compressor with perfect inter cooling takes in air at 1 bar pressure and 27^0C. The Law of compression in both stages is $PV^{1.3} = C$. The compressed air is delivered at 10 bar from the Hp cylinder to an air receiver. Calculate per kg of air
i) The minimum work done ii) Heat rejected in the intercooler
iii) The minimum work done in a three stage compressor working under the same conditions. **(08 Marks)**

OR

10 a. With neat sketch, explain open cycle gas turbine and closed cycle gas turbine. **(08 Marks)**

b. Air is drawn in a gas turbine at 18^0C and 1bar and leaves the compressor at 5 bar. Data observed are : Temperature of gases entering the turbine = 678^0C .
Pressure loss in combustion chamber = 0.1 bar ; Efficiency of compressor = 85 %
Efficiency of combustion = 85% ; Efficiency of turbine = 80%.
Y = 1.4 for air , C_p = 1.024 kJ/kg K for gases.
Find i) Quantity of air if plant develops 1065 kw.
ii) Heat supplied per kg of air circulated.
iii) Thermal efficiency of the cycle. **(08 Marks)**

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