CBCS SCHEME

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Third Semester B.E. Degree Examination, Jan./Feb. 2021
Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamic data handbook, steam tables, psychrometry chart allowed.

Module-1

1 a. Define thermodynamics and briefly explain the following with example:
i) Closed system ii) Open system iii) Isolated system. **(08 Marks)**

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

c. The readings t_A and t_B of two celsius thermometers A and B agree 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 constant; when both thermometers are immersed in a system of fluid, A registers 11°C while B registers 10°C. Determine the reading on A when B registers 30°C. **(06 Marks)**

OR

2 a. Define work and heat. Write three important similarities between them. **(06 Marks)**

b. Derive an expression for work done during isothermal process. **(06 Marks)**

c. A cylinder contains 1kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to law PV^2 = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regain its origin at position. Heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the network done by the fluid, for an initial volume of $0.05m^3$. **(08 Marks)**

Module-2

3 a. What is PMMK-I? Write the limitation of first law of thermodynamics. **(04 Marks)**

b. Write steady flow energy equation and apply SFEE for nozzle. **(08 Marks)**

c. A steam turbine receives a steam flow of 4540kg/hr and delivers 5000kW. The heat loss from the turbine is negligible. Find the change in enthalpy across the turbine. If the velocity of the steam at entrance is 61m/sec and at exit is 366m/sec. The inlet pipe is 3m above the exhaust. **(08 Marks)**

OR

4 a. Write the Kelvin planks and Clausius statement with neat block diagram. **(06 Marks)**

b. Prove that entropy is a property of a system. **(08 Marks)**

c. A carnot refrigerator operates in a room which is at a temperature of 25°C the C.O.P of the refrigerator is 4.5 and it consumes 0.5kW of power. Determine:
i) The rate of heat removed from the refrigerated space
ii) The temperature of the refrigerated space. **(06 Marks)**

Module-3

5 a. Analyze the flue gasses by using orsat apparatus with neat sketch. **(10 Marks)**

b. With the help of P-V and T-S diagram. Derive an expression for thermal efficiency of otto cycle interms of compression ratio. **(10 Marks)**

OR

6 a. Define the following terms with respect to I.C. engine: i) Brake power ii) Indicated power iii) Thermal efficiency iv) Mechanical efficiency v) Specific fuel consumption. **(05 Marks)**

b. Explain Morse test method of determining indicated power and hence the frictional power of I.C. engine. **(05 Marks)**

c. The following observations were made during a test on a two stroke oil engine. Room temperature = 22°C, Bore = 20cm, Stroke = 25cm, Speed = 350rpm, Brake drum diameter = 1.2m, Net brake load = 450N, Mean effective pressure = 2.8bar, Oil consumption = 3.6kg/hr, Calorific value of oil = 41800kJ/kg, Quantity of jacket cooling water = 455kg/hr, Rise in temperature of jacket water = 28°C. Temperature of exhaust gases entering and leaving the exhaust gas calorimeter are 320°C and 220°C respectively. Quantity of water passing through the exhaust gas calorimeter is 8kg/min. Temperature rise of calorimeter water = 9°C. Determine the indicated and brake power, mechanical efficiency and brake thermal efficiency. Draw the heat balance sheet on one minute basis. Take C_p of water is 4.187kJ/kgK. **(10 Marks)**

Module-4

7 a. Explain steam jet refrigeration system with a neat sketch. **(06 Marks)**

b. Write the desirable properties of good refrigerant. **(06 Marks)**

c. 28 tons of ice from and at O°C is produced per day from water at 20°C in an NH_3 refrigerator. The temperature range in the compressor is from 25°C to -15°C the vapour is dry and saturated at the end of compression and an expansion value is used assuming C.O.P of 62% of theoretical, calculate the power required to drive the compressor. Take latent heat of ice = 335kJ/kg properties of refrigerant.

t°C	Enthalpy kJ/kg		Entropy kJ/kg°C	
	Liquid h_f	Vapour h_f	Liquid s_f	Vapour s_f
25	100.04	1319.12	0.3473	4.4852
-15	-54.56	1304.99	-2.1338	5.0585

(08 Marks)

OR

8 a. Define the following: i) Super saturated air mixture ii) Dew point iii) Relative humidity iv) Wet bulb temperature v) Dry bulb temperature vi) COP **(06 Marks)**

b. With neat sketch describe the working of summer air-conditioning system for hot and dry weather. **(08 Marks)**

c. The dry and wet bulb thermometers read 35°C and 25°C and the barometer reading is 760mm of Hg using tables. Calculate: i) Specific humidity ii) Relative humidity iii) Enthalpy of air per kg of dry air. **(06 Marks)**

Module-5

9 a. Derive the work done in a single stage compressor neglecting cleanse volume. **(08 Marks)**

b. Write the advantages of multistage compressor and limitation of single stage compressor. **(08 Marks)**

c. A single stage acting air compressor 30cm bore and 40cm stroke is running at a speed of 100RPM. It takes in air at 1 bar and 20°C and compresses it to a pressure of 5 bar. Find the power required. When the compression is i) Isothermal ii) $PV^{1.2} = C$ Take R = 0.287kJ/kgK. **(04 Marks)**

OR

10 a. With neat sketch, explain the turbojet engine and write the advantages and limitations. **(08 Marks)**

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

c. In a simple gas turbine plant air is compressed from 1 bar and 25°C through a pressure ratio of 4:1. It is then heated by 150°C in a combustion chamber and expanded back to atmospheric pressure of 1 bar in the turbine calculate the cycle efficiency and the turbine outlet temperature. **(04 Marks)**

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