CBCS Scheme

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15AU33

Third Semester B.E. Degree Examination, June/July 2017

Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Distinguish between :
i) Macroscopic and Microscopic approach of study
ii) Intensive and Extensive properties. **(04 Marks)**

b. Explain thermodynamic equilibrium. **(04 Marks)**

c. The readings of T_A and T_B of two Celsius thermometers A and B agree at ice point and steam point. But they are related by the equation $T_A = \ell + m T_B + n T_B^2$, where ℓ, m, and n are constants. When both the 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 37.4 °C. **(08 Marks)**

OR

2 a. Differentiate between work and Heat. **(04 Marks)**

b. Derive an expression for displacement work in a polytropic process. **(05 Marks)**

c. Specific Heat capacity of the system during certain process is given by $C_p = (0.4 + 0.004T)$ kJ/kg °C. If the mass of the gas is 6kg and its temperature changes from 25°C to 125°C, Find the heat transferred. **(07 Marks)**

Module-2

3 a. State 1st law of thermodynamics applied to cyclic process. show that internal energy is a property of the system. **(08 Marks)**

b. Give Kelvin-Plank and Clausius statements of second law of thermodynamics and show that violation of Clausius statement leads to violation of Kelvin Planck's statement. **(08 Marks)**

OR

4 a. State and prove Clausius inequality. **(06 Marks)**

b. What is available and unavailable energy? **(04 Marks)**

c. An inventor claims that his engine has following specifications, power developed equal to 75kW, temperature limits 750°C and 25°C, fuel burned per hour is 3.9kg, and heating value of fuel is 74500kJ/kg. State whether his claim valid or not. **(06 Marks)**

Module-3

5 a. Define stoichiometric air and percentage excess air. **(04 Marks)**

b. Describe diesel cycle with P-V and T-S diagrams and derive an expression for efficiency in terms of compression ratio, cut off ratio and ratio of specific heats. **(12 Marks)**

OR

6 a. Explain briefly the following with respect to IC engines.
i) William line method ii) Morse test. **(06 Marks)**

b. During the test on single cylinder oil engine, working on four stroke cycle and fitted with a rope brake, the following readings are taken.
Effective diameter of brake drum = 630mm, dead load on brake = 200N, Spring balance reading = 30N, Speed = 450rpm, Area of indicator diagram = 420mm^2, Length of indicator diagram = 60mm, Spring scale = 1.1 bar per mm, Cylinder diameter = 100mm, Stroke = 150mm, Mass of oil = 0.815 kg/hr, C.V of oil = 42000 kJ/kg. Calculate brake power, Indicated power, Mechanical efficiency, Break thermal efficiency and Brake specific fuel consumption. **(10 Marks)**

Module-4

7 a. What is Refrigeration? Explain with the neat sketch the working principle of vapour absorption refrigeration system. **(08 Marks)**

b. A vapour compression refrigerator uses F -12 as refrigerant and liquid evaporates in the evaporator at – 15°C. The temperature of this refrigerant at the delivery from the compressor is 15°C, then the vapour is condensed at 10°C. Determine the COP if there is no under cooling. Take specific heat at constant pressure for super heated vapour as 0.64 kJ/kg K and that for liquid as 0.938 kJ/kg K. **(08 Marks)**

OR

8 a. Define specific humidity and Degree of saturation. **(04 Marks)**

b. With neat sketch, briefly describe winter Air conditioning system. **(06 Marks)**

c. One kg of air at 40°C DBT and 50% RH is mixed with 2 kg of air at 20°C DBT and 20°C DPT. Calculate the temperature and specific humidity of the mixture. **(06 Marks)**

Module-5

9 a. Define the following with respect to reciprocating air compressor i) Isothermal efficiency ii) Isentropic efficiency iii) Mechanical efficiency. **(06 Marks)**

b. Obtain an expression for volumetric efficiency of a single stage air compressor in terms of clearance ratio, pressure ratio and index of compression and explain the effect of clearance on the volumetric efficiency. **(10 Marks)**

OR

10 a. Explain with neat sketch, the differences between open and closed cycle gas turbines. **(06 Marks)**

b. A gas turbine unit has a pressure ratio of 6:1 and maximum cycle temperature of 610°C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilo watts of an electric generator geared to the turbine when air enters the compressor at 15°C at the rate of 16kg/sec.
Take C_p = 1.005 kJ/kg K and γ = 1.4 for the compression process and take C_p = 1.11 kJ/kg K and γ = 1.333 for the expansion process. **(10 Marks)**

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