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CBCS SCHEME

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18MR43

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamics Data Handbook is permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Represent Otto, diesel and dual cycle on p-v diagram and T-S diagram when heat supplied on each cycle is the same. Prove that Otto cycle gives the highest efficiency. **(10 Marks)**

b. The data corresponding to Otto cycle are the following:
Maximum temperature = 1700K, minimum temperature = 300K, compression ratio = 7, pressure at the beginning of compression process = 1atm. C_p and C_v are constants r = 1.4. Determine:
i) Pressure and temperature at each point in the cycle
ii) Thermal efficiency
iii) Work ratio
iv) Mean effective pressure. **(10 Marks)**

OR

2 a. With neat sketch, explain open cycle constant pressure gas turbine. **(08 Marks)**

b. Differentiate between gas turbine and steam turbine. **(04 Marks)**

c. A carnot heat engine connects one-fifth of the heat input into power output. If the temperature of the sink is reduced by 100°C, its η is doubled. Find the temperature of the source and the sink. **(08 Marks)**

Module-2

3 a. Draw the ideal regenerative vapour power cycle on temperature entropy diagram. What are its advantages? How is the cycle approximated in practice? **(10 Marks)**

b. A steam power plant receives heat from a heat source at the rate of 100MW. The plant operates with a boiler pressure of 40bar and a condenser pressure of 0.1 bar. If the plant is designed to operate ideally on the basic Rankine cycle. Calculate:
i) The cycle efficiency
ii) The work ratio for the cycle
iii) The power output of the plant
iv) The required mass flow rate of the working fluid and
v) The Specific Steam Consumption (S.S.C. in kg/kwh). **(10 Marks)**

OR

4 a. Explain the working of simple Rankine cycle with neat sketch, PV and T-S diagram. **(10 Marks)**

b. Steam at 4MPa, 300°C leaves the boiler and enters the high pressure turbine and is expanded to 400kPa. The steam is then reheated to 300°C and expanded in the LP turbine to 10kPa. Calculate thermal efficiency if it is to be internally reversible. **(10 Marks)**

Module-3

5 a. With neat sketch, explain Orsat apparatus. **(06 Marks)**

b. Define:
   i) Airfuel ratio
   ii) Enthalpy of formation
   iii) Volumetric efficiency
   iv) Enthalpy of combustion. **(06 Marks)**

c. Determine the theoretical air-fuel ratio for combustion of octane. **(08 Marks)**

OR

6 a. Explain the following:
   i) Adiabatic flame temperature
   ii) Stoichiometric air
   iii) Combustion efficiency
   iv) Incomplete combustion. **(10 Marks)**

b. Butane is burned with air and volumetric analysis of the combustion products on dry basis yields the following composition:

Gas :	CO_2	CO	O_2	N_2
Percentage :	7.8	1.1	8.2	82.9

Determine the percentage of theoretical air used. For theoretical combustion the products are CO_2, H_2O, N_2. **(10 Marks)**

Module-4

7 a. Explain the following:
   i) Morse test
   ii) Heat balance sheet **(10 Marks)**

b. During a test on the engine, the following data were recorded. Stroke = 4, Bore = 12cm, Stroke = 15cm, Speed = 1500rpm, Brake torque = 150Nm, Fuel consumption = 6kg/h, orifice diameter = 3cm, calorific value = 42000kJ/kg. Number of cylinder = 1, Head across the orifice = 6cm of H_2O, Room temperature = 20°C, Pressure = 1 bar.
Calculate:
   i) Brake thermal efficiency
   ii) Brake mean effective pressure
   iii) Volumetric efficiency based on free air conditions. **(10 Marks)**

OR

8 a. With neat sketch, explain Willian's line method for torque measurement. **(06 Marks)**

b. Define the following:
   i) Volumetric efficiency
   ii) Air-Fuel ratio. **(04 Marks)**

c. A full load test on a 2-stroke engine gave the following data:
Speed = 450rpm, Brake load = 460N, imep = 3 bar, Fuel consumption = 5.4kg/hr, jacket water flow rate = 440kg/hr. Temperature rise of cooling water = 36°C, Air fuel ratio = 31:1, Temperature to exhaust gases = 355°C, Room temperature = 20°, Calorific value = 42000kJ/kg. Cylinder bore = 220mm, Stroke = 270mm, Brake drum diameter = 1500mm, Mean specific heat of exhaust gases = 1.02kJ/kg K. Determine :
   i) Indicated thermal efficiency
   ii) Draw the heat balance sheet. **(10 Marks)**

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Module-5

9 a. With neat sketch, explain vapour compression refrigeration system. **(10 Marks)**

b. A reversed cycle has refrigerating COP of 4. Determine:

i) The ratio of T_2/T_1, or T_{max}/T_{min}.

ii) If the workdone on the cycle is 20kW, determine the maximum refrigeration effect in ton

iii) If this cycle is used as heat pump, determine the COP and heat delivered. **(10 Marks)**

OR

10 a. Explain the following:

i) Dew point temperature

ii) Wet bulb temperature

iii) Dry bulb temperature

iv) Specific humidity

v) Degree of saturation or saturation ratio. **(10 Marks)**

b. The moist air is at temperature of 20°C under a total pressure of 740mm Hg. The dew point temperature 15°C. Find:

i) The partial pressure of water vapour

ii) The relative humidity

iii) The specific humidity

iv) The specific enthalpy of water vapour by three methods

v) The enthalpy of air per kg of dry air

vi) The specific volume of air per kg of dry air. **(10 Marks)**

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