CBCS SCHEME

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18MR43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
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 thermodynamic data hand book/charts/tables is permitted.

Module-1

1 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of Diesel cycle. **(10 Marks)**

b. An engines of 250mm bore and 375mm stroke works on constant volume cycle. The clearance volume is $0.00263m^3$. The initial pressure and temperature are 1 bar and 50°C. If maximum pressure is 25 bar find: i) Air standard efficiency of the cycle ii) Mean effective pressure. **(10 Marks)**

OR

2 a. Derive an expression for maximum work output for a Brayton cycle. **(10 Marks)**

b. The compressor and turbine units of a simple gas turbine have an isentropic efficiency of 85% the inlet air temperature is 15°C and the maximum temperature of the gas 800°C, while the pressure range is from 1 bar to 4 bar. Determine:
i) The overall cycle efficiency.
ii) Net work output.
iii) Work ratio.
Take $C_p = 1.051$ and $C_v = 0.749$kJ/kg K. **(10 Marks)**

Module-2

3 a. With the help of a schematic diagram and T-S diagram, explain the working of a Rankine cycle and derive an expression for the overall efficiency. **(10 Marks)**

b. A steam turbine working on a Rankine cycle is supplied with dry saturated steam at 25 bar and the exhaust takes place at 0.2 bar. For a steam flow rate of 10kg/s, determine: i) Quality of steam at the end of expansion ii) Turbine shaft work iii) Work ratio iv) Rankine cycle efficiency v) Heat loss in condenser. **(10 Marks)**

OR

4 a. With the help of a schematic diagram and T-S diagram, explain the working of a Rankine reheat cycle. **(06 Marks)**

b. Write a note on Feed water heaters. **(04 Marks)**

c. A steam power station uses the following cycle steam at boiler outlet, 150 bar, 550°C. Reheat at 40 bar, 550°C, condenses at 0.1 bar. Using Molliar chart and assuming that all processes are ideal, find: i) Quality at turbine exhaust ii) Cycle efficiency iii) Steam rate. **(10 Marks)**

Module-3

5 a. Explain the following with reference to a combustion process:
i) Percent excess air
ii) Enthalpy of formation
iii) Adiabatic flame temperature
iv) Enthalpy of combustion. **(08 Marks)**

b. The product of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by an orsat apparatus CO_2 = 8%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine: i) The composition of the fuel ii) The air fuel ratio iii) The percent excess air used. **(12 Marks)**

OR

6 a. Explain the flue gas analysis with orsat apparatus. **(08 Marks)**

b. The fuel sample has the percentage analysis by mass as follows. C → 81%, O_2 → 5%, H_2 → 5%, moisture → 2% and Ash → 7%. Calculate theoretical minimum air required for complete combustion of 1kg of the fuel. Also calculate the volumetric analysis of dry flue gases, if actual air supplied is 6kg per kg of fuel. Assume that 80% of carbon is burnt to CO_2 and remaining to CO. Hydrogen from the fuel burned completely. **(12 Marks)**

Module-4

7 a. Define following terms: i) Indicated power ii) Brake power iii) Mechanical efficiency iv) Specific fuel consumption v) Frictional power. **(10 Marks)**

b. An 8 cylinder, 4 stroke petrol engine of 90mm bore and 80mm stroke with a compression ratio of 7 is tested at 4500rpm on a dynamometer with 540mm arm. During 10 minute test, the dynamometer reading was 412N and engine consumed 4.4kg of petrol. Air at 27°C and 1 bar entered through the venturi at a rate of 6kg/min. Assuming CV_f = 44MJ/kg. Find: i) BP developed ii) Brake mep iii) bsfc iv) η_{bt} v) AF ratio vi) η_v. **(10 Marks)**

OR

8 a. Explain briefly the following frictional power determination methods:
i) Williams line method ii) Morse test method. **(08 Marks)**

b. The following observations were made during one hour test on a single cylinder 4-stroke oil engine. Bore = 300mm, stroke = 450mm, mass of fuel used = 8.8kg, calorific value = 41800kJ/kg, average speed = 200rpm m.r.p = 5.8 bar, brake load = 1860N, mass of loading water circulated = 650kg, temperature rise = 22°C, diameter of brake drum = 1.22m. Calculate: i) η_{mesh} ii) η_{bt} iii) heat balance sheet. **(12 Marks)**

Module-5

9 a. Write the desirable properties of a refrigerant. **(08 Marks)**

b. Define the following: i) COP ii) Ton of refrigeration. **(04 Marks)**

c. Explain working of V.C.R system, with flow diagram and T-S diagram. **(08 Marks)**

OR

10 a. With neat schematic diagrams clearly explain summer and winter air conditioning. **(10 Marks)**

b. Define: i) Relative humidity ii) Specific humidity iii) Dew point temperature iv) Enthalpy of humid air v) Degree of saturation. **(10 Marks)**

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