CBCS SCHEME

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18MR43

Fourth Semester B.E. Degree Examination, June/July 2023
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Thermodynamics data hand book / chart permitted.

Module-1

1 a. With P-V and T-S diagrams, derive an expression for air standard efficiency of a diesel cycle interms of compression ratio and cut off ratio. **(10 Marks)**

b. In an air standard diesel cycle, the compression ratio is 1b, and at the beginning of isentropic compression, the temperature is 15°C and the pressure is 0.1MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate: i) The cut off ratio ii) The heat supplied per kg of air iii) the cycle efficiency and iv) M.E.P. **(10 Marks)**

OR

2 a. Derive an expression for optimum pressure ratio for maximum specific work output for an ideal gas turbine cycle. **(10 Marks)**

b. The compressor and turbine 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) Network 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 flow diagram and T-S diagram of a simple steam power plant. Write the drawback of carnot cycle. **(10 Marks)**

b. A steam engine uses steam at 10 bar and 0.9 dry and exhaust at 1.1 bar determine: i) Rankine cycle efficiency ii) the percentage increase in efficiency if the steam has at a temperature of 200°C before entering the cylinder. **(10 Marks)**

OR

4 a. With a schematic diagram, explain the working of reheat vapour power cycle and deduce an expression for cycle efficiency. **(08 Marks)**

b. A steam power station uses the following cycle:
I. Steam at boiler outlet 150 bar, 550°C
II. Reheat at 40 bar, 550°C.
III. Condensation at 0.1 bar. Using mollier chart and assuming that all processes are ideal.
Find: i) quality of steam at turbine exhaust ii) Cycle efficiency iii) Steam rate. **(12 Marks)**

Module-3

5 a. Define:
i) Theoretical air
ii) Enthalpy of combustion
iii) Adiabatic flame temperature
iv) Enthalpy of formation. **(08 Marks)**

b. A sample of fuel has the following percentage composition by weight. Carbon C → 86%, hydrogen H_2 = 8%, sulphur S ⇒ 3%, oxygen O_2 → 2%, Ash – 1%.
i) Determine the stochiometric air fuel ratio by mass.
ii) If 20% excess air is supplied.
Find the percentage composition of dry flue gases by mass and by volume. **(12 Marks)**

OR

6 a. With a neat sketch, explain ORSAT apparatus. **(08 Marks)**

b. The products of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by the ORSAT operator CO_2 – 8%, CO – 0.9%, O_2 – 8.8%, N_2 – 82.3%. Determine by mass i) The composition of the fuel ii) Air fuel ratio iii) % excess air used. **(12 Marks)**

Module-4

7 a. Define the following with respect to I.C engine:
i) Indicated power
ii) Brake power
iii) Mechanical efficiency
iv) Indicated thermal efficiency
v) Brake thermal efficiency
vi) Brake specific fuel consumption. **(06 Marks)**

b. Write a note on:
i) Ratings of IC Engine fuels
ii) Alternate fuels. **(08 Marks)**

c. With a neat sketch, explain rope brake drum dynamometer to measure torque. **(06 Marks)**

OR

8 a. Explain:
i) William's line method
ii) Morse test. **(08 Marks)**

b. The following data were recorded during a test on a single cylinder 4 stroke oil engine. Bore = 150mm, stroke = 300mm, speed = 18000rph, brake torque = 200Nm, indicated mean effective pressure (Imep) = 7 bar, fuel consumption = 204kg/hr, cooling water flow rate = 5kg/min, cooling water temperature raise = 30°C, air fuel ratio = 22, exhaust gas temperature = 410°C, specific heat of exhaust gases = 1kJ/kg K, room temperature = 20°C, calorific value of fuel = 42MJ/kg. Determine: i) Mechanical efficiency ii) BSFC iii) Draw the heat balance sheet on minute basis and percentage basis. **(12 Marks)**