CBCS Scheme

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15MR43

Fourth Semester B.E. Degree Examination, June/July 2018
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: **1.** ***Answer any FIVE full questions, choosing one full question from each module.***
2. ***Use of thermodynamic data handbook is required.***

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.

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Module-1

1 a. Define the following:
i) Stochiometric air ii) Enthalpy of combustion
iii) Adiabatic flame temperature iv) Excess air **(08 Marks)**

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

OR

2 a. Derive the equation for minimum air required for complete combustion. **(06 Marks)**

b. Butane (C_4H_{10}) is burned with air and volumetric analysis of combustion of products on dry basis yields following constituents CO_2 = 7.8%, CO = 1.1%, O_2 = 8.2%, N_2 = 82.9%. Determine: i) % theoretical air, ii) % excess air. **(10 Marks)**

Module-2

3 a. What are the methods to find friction power? Explain Morse test method. **(06 Marks)**

b. The following readings were taken during the test of a single cylinder four stroke old engine.
Cylinder dia = 250 mm
Stroke = 400 mm
Gross MEP = 7 bar
Pumping MEP = 0.5 bar
Speed = 250 rpm
Net load on the brake = 1080 N
Effective diameter of the brake = 1.5 m
M_f = 10 kg/hr
Calorific value = 44300 kJ/kg
Calculate:
i) IP
ii) BP
iii) Mechanical efficiency
iv) Indicated thermal efficiency
v) Brake thermal efficiency **(10 Marks)**

OR

4 a. Derive an expression for work done in a single stage compressor neglecting clearance. **(08 Marks)**

b. A single cylinder single acting air compressor compresses 0.7 kg/min of air according to $PV^{1.3} = C$ from 1 bar , 25°C to 7 bar while running at 600 rpm. The clearance volume is $1/25^{th}$ of stroke volume which is 1.2 ltrs. The mechanical efficiency is 81%. Calculate:
i) Volumetric efficiency
ii) Actual power required to drive the compressor. **(08 Marks)**

Module-3

5 a. Explain regenerative steam cycle with open feed water heater. **(08 Marks)**

b. Discuss the effects of boiler pressure and super heat on the Rankine cycle. **(08 Marks)**

OR

6 a. Derive the expression for thermal efficiency of otto cycle with the help of PV and T-S diagrams. **(06 Marks)**

b. In an air standard diesel cycle, The compression ratio is 16. At the beginning of isentropic compression, the temperature is 15°C and pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate:

i) Cut off ratio ii) Heat supplied per kg of air

iii) Cycle efficiency iv) Mean effective pressure **(10 Marks)**

Module-4

7 a. What are the methods to improve efficiency of gas turbine? Explain regenerative method. **(06 Marks)**

b. Derive an expression for max pressure ratio (r_p) and optimum pressure ratio ($r_{p_{opt}}$) for an Brayton cycle with the help of PV and TS diagram. Write the assumptions. **(10 Marks)**

OR

8 a. With a neat sketch, explain Ramjet engine. **(06 Marks)**

b. In a gas turbine plant air is compressed from 98.1 kPa and 15°C through a pressure ratio of 4:1. It is then heated to 650°C in a combustion chamber and expanded back to the atmospheric pressure efficiencies of turbine and compressor are 85% and 80% respectively. Calculate: (i) Cycle efficiency, (ii) Work ratio. **(10 Marks)**

Module-5

9 a. What are desirable properties of refrigerants? Explain briefly. **(06 Marks)**

b. A vapour compression refrigerator working with Freon-12 has its temperature range −10°C and 30°C. The vapour enters the compressor on dry saturated and under cooled by 5°C in the condenser. For a capacity of 15 TR (Ton of refrigeration). Find: (i) COP, (ii) Mass of Freon, (iii) Power required where C_{pv} = 0.56 kJ/kgK, $C_{P_{liq}}$ = 1.003 kJ/kgK. **(10 Marks)**

OR

10 a. Define:

i) Specific humidity

ii) Saturated air

iii) Relative humidity

iv) Wet bulb temperature. **(08 Marks)**

b. Moist air at 35°C has a dew point of 15°C. Calculate its relative humidity, specific humidity and enthalpy (h). Take C_{p_v} = 1.88 kJ/kg. **(08 Marks)**

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