CBCS SCHEME

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18MR43

Fourth Semester B.E. Degree Examination, July/August 2022
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

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.

VTU EXAMS JULY-AUGUST 2022

Module-1

1 a. Derive an expression for Efficiency and Mean effective pressure for diesel cycle. **(08 Marks)**

b. In a constant volume Otto cycle the pressure at the end of compression is 15 times that at the start. The temperature and volume of air at the beginning of compression is 38°C and 0.45m^3 respectively. Maximum temperature attained in the cycle is 1950°C. Determine
i) Compression ratio ii) Thermal efficiency iii) Maximum pressure iv) Work done. Take $C_{P_{air}}$ = 1 kJg / kg K and C_V = 0.706 kJ / kg K. **(12 Marks)**

OR

2 a. Explain the different methods of Improving the efficiency of Brayton cycle and explain Intercooling methods for Brayton cycle. **(08 Marks)**

b. A gas turbine unit receives air 1 bar and 300K and compresses adiabatically to 6.2 bar. The compressor efficiency is 88%. The fuel has a heating value of 44186 kJ/kg and the fuel air ratio is 0.017 kJ/kg air. The turbine internal efficiency is 90%. Calculate the work of turbine and compressor per kg of air compressed and thermal efficiency. **(12 Marks)**

Module-2

3 a. With a schematic diagram, explain the working of regenerative vapour power cycle and deduce the expression for cycle efficiency. **(10 Marks)**

b. In a steam turbine steam at 20 bar , 360°C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes, find per kg of steam the network and the cycle efficiency. **(10 Marks)**

OR

4 a. With help of neat diagram and corresponding T-S diagram of reheat vapour power cycle and derive an expression for the reheat cycle efficiency. **(08 Marks)**

b. In a single – heater regenerative cycle the steam enters the turbine at 30bar, 400°C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find the efficiency and steam rate of the cycle. **(12 Marks)**

Module-3

5 a. Explain the following : i) Enthalpy of formation ii) Enthalpy of combustion iii) Stoichiometric air iv) Percentage of excess air v) Adiabatic flame temperature. **(10 Marks)**

b. Solid fuel has the following % of composition C – 86% ; H – 8% ; S – 3% ; O_2 – 2% ; Ash – 1%. For an air fuel ratio of 12 : 1. Calculate i) Mixture strength as % rich or weak. ii) Volumetric analysis of dry products of combustion. **(10 Marks)**

OR

6 a. With a neat sketch, explain the analysis of exhaust gases by Orsat apparatus. **(08 Marks)**

b. The product of combustion of an unknown hydrocarbon $C_x H_y$ have following composition as measured by an ORSAT apparatus $CO_2 = 8\%$; $CO = 0.9\%$; $O_2 = 8.8\%$; $N_2 = 82.3\%$
Determine i) Composition of fuel ii) A/F ratio.
iii) % of excess air and theoretical air. **(12 Marks)**

Module-4

7 a. Explain the following : i) Willian's line method ii) Morse Test. **(08 Marks)**

b. Following particulars were obtained in a trail on a 4 – stroke gas engine :
Duration of Trial = 1 hour ; Revolution = 14000 ; No. of missed cycle = 500
Net brake load = 1470 N ; Mean effective pressure = 7.5 bar ;
Gas consumption = 20,000 liters ; LCV of gas at supply condition = 21kJ/liter ;
Cylinder diameter = 250mm ; Stroke = 400mm ; Effective brake circumference = 4m
Compression Ratio = 6.5 : 1. Calculate : i) Ip ii) Bp iii) Mechanical efficiency
iv) Indicated thermal efficiency v) Relative efficiency. **(12 Marks)**

OR

8 a. Explain briefly the stages of combustion of S.I engines. **(08 Marks)**

b. In a trial of single cylinder oil engine working dual cycle, the following observations were made : Compression ratio is 15 ; Oil consumption = 10.2 kg/hr
Calorific value = 43,890 kJ/kg ; Air consumption = 3.8 kg/min ; Speed = 1900 rpm ;
Torque on brake drum = 186 N-m ; Quantity of cooling water used = 15.5kg/min ;
Temperature rise of water = 36°C ; Exhaust gas temperature = 410°C
Room temperature = 20°C ; C_p of exhaust gas = 1.17 kJ/kg K.
Calculate : i) BP ii) BSFC
iii) Brake thermal efficiency and draw the heat balance sheet on minute basis. **(12 Marks)**

Module-5

9 a. With a neat sketch, describe clearly the working of a Vapour absorption refrigeration system. **(08 Marks)**

b. A refrigeration machine is required to produce ice at 0°C from water at 20°C. The machine has a condenser temperature of 298K while the evaporator temperature is 268K. The relative efficiency of the machine is 50% and 6kg of Freon – 12 refrigerant is circulated through the system per minute. The refrigerant enters the compressor with a dryness fraction of 0.6. Specific heat of water is 4.187kJ/kg K and the latent heat of ice is 335kJ/kg. Calculate the amount of ice produced in 24 hours. The table properties of Freon are below :

Temperature K	Liquid heat kJ/kg	Latent heat kJ/kg	Entropy kJ/kg
298	59.7	138.0	0.2232
268	31.4	154.0	0.1251

(12 Marks)

OR

10 a. Define i) Specific humidity ii) Relative humidity iii) Degree of saturation. **(06 Marks)**

b. With neat sketch, describe the working of Winter Air Conditioning System. **(08 Marks)**

c. The atmospheric conditions are : 20°C and Specific humidity of 0.0095 kJ/kg of dry air. Calculate the following : i) Partial pressure of vapour ii) Relative humidity.
iii) Dew point temperature. **(06 Marks)**

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