CBCS SCHEME

USN 1 AH 15 ME 071

15ME43

Fourth Semester B.E. Degree Examination, June/July 2023
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 and Steam tables 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. Derive the expression for Air standard efficiency for Diesel cycle. **(08 Marks)**

b. An engine of 250mm bore and 375mm stroke works on Otto – cycle. The clearance volume is $0.00263m^3$. The initial pressure and temperature are 1 bar and 50°C. if the maximum pressure is limited to 25bar. Find the following : i) Air standard efficiency of the cycle ii) The mean effective pressure for the cycle. Assume Ideal conditions. **(08 Marks)**

OR

2 a. With neat sketch, explain the working principle of Ramjet and Turbo Jet Engine. **(08 Marks)**

b. In an open cycle gas turbine plant air enters the compressor at 1 bar and 27°C. The pressure after compression is 4 bars. The isentropic efficiency of the turbine and compressor are 85% and 80% respectively. Air fuel ratio is 80%. Calorific value of the fuel is 42,000 kJ/kg. Mass flow rate of air is 2.5 kg/s. Determine the power output from the plant and cycle efficiency. Assume $C_p = 1.0$ kJ/kg °K , $\gamma = 1.4$ for air and gases. **(08 Marks)**

Module-2

3 a. With PV and TS diagram, explain the performance on Rankine cycle i) Effect of condenser pressure ii) Effect of boiler pressure. **(08 Marks)**

b. In a Ranking cycle , the maximum pressure of steam supplied is 6 bar. The dryness fraction is 0.9. The exhaust pressure is 0.7 bars. Find the theoretical work done and Rankine efficiency. **(08 Marks)**

OR

4 a. With block diagram, explain the working principle of Reheat Rankine cycle and derive the efficiency of the cycle. **(08 Marks)**

b. An ideal Rankine cycle with reheat is designated to operate according to the following specifications. Pressure of steam at HPT inlet is 20MPa , Temperature of steam at HPT is 550°C , Temperature at end of reheat is 550°C , Pressure of steam at the turbine exhaust is 15KPa , Quality of steam at turbine exhaust is 90%. Determine i) Pressure of steam in reheater ii) Ratio of pump work to turbine work iii) Ratio of heat rejection to heat addition iv) Cycle thermal efficiency. **(08 Marks)**

Module-3

5 a. Define the following with reference to Combustion process : i) Air – Fuel ratio ii) Enthalpy of formation iii) Adiabatic flame temperature iv) Combustion efficiency. **(08 Marks)**

b. Methane (CH_4) is burnt with atmospheric air. The analysis of products is given as follows : $CO_2 = 10\%$, $O_2 = 2.37\%$, $CO = 0.53\%$, $N_2 = 87.1\%$.
i) Write the combustion equation ii) Calculate the air fuel ratio
iii) Percentage theoretical air. **(08 Marks)**

OR

6 a. Explain the following to find FP : i) Willan's Line method and ii) Morse test. **(08 Marks)**

b. The following particulars refer to a 2 – Stroke engine , Bore = 20cm , Stroke = 30cm , Speed = 350 rpm , Indicated mean effective pressure = 275 kN/m^2 , Net brake load = 610N , Dia. of brake drum = 1m , Oil consumption = 4.25 kg/hr , Calorific value of fuel = 44000kJ/kg. Determine i) IP ii) BP iii) η_{mech} iv) Indicated thermal efficiency. **(08 Marks)**

Module-4

7 a. With neat sketch, explain the working principle of vapour absorption refrigeration system and derive the expression for C.O.P of the system. **(08 Marks)**

b. In an air – standard refrigeration cycle, air enters the compressor at 1 bar and 10°C and leaves at 5.1 bar. Air enters the expander at 30°C. Find COP for the cycle. Calculate the rate at which air must enter the compressor to produce a refrigerating effect of 1 ton refrigeration. **(08 Marks)**

OR

8 a. Define the following : i) Dry bulb temperature ii) Wet bulb temperature iii) Dew point temperature iv) Specific humidity. **(08 Marks)**

b. A room measures 5m × 5m × 3m. It contains atmosphere air at 100 KPa , DBT = 20°C and RH = 30%. Find the mass of dry air and the mass of water vapour in the room. **(08 Marks)**

Module-5

9 a. Derive the expression for minimum work done in a 2 – stage compressor with perfect inter cooling. **(08 Marks)**

b. A single stage reciprocating compressor takes 1m^3 of air per minute at 1.013 bar and 15°C and delivers it at 7 bar. Assuming that the law of compression is $PV^{1.35} = C$ and clearance is negligible. Calculate the indicated power. **(08 Marks)**

OR

10 a. Derive an expression for velocity of steam leaving from nozzle in terms of pressure ratio and expansion index. **(08 Marks)**

b. Steam expands from 17 bar and 284°C to 0.7 bar in a Convergent – Divergent nozzle. Assuming that expansion is frictionless and the steam discharge is 0.25 kg/s. Calculate the diameter of the nozzle.

i) At a point where the pressure is 9.5 bar.

ii) At exit using H – S chart. **(08 Marks)**

* * * * *