PVP 19

Code: 19ME3402

II B.Tech - II Semester – Regular Examinations – AUGUST 2021

APPLIED THERMODYNAMICS
(MECHANICAL ENGINEERING)

Psychrometry Charts will be provided

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 5 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each question carries 12 marks.
4. All parts of Question paper must be answered in one place

PART – A

1. a) For heavy vehicles, which engine would you prefer SI engine or CI engine? Why?
   b) Explain how the following parameters influence the knock in SI engines (i) speed (ii) compression ratio.
   c) Define steam rate and heat rate.
   d) What are the factors influencing the air-standard efficiency of Brayton cycle?
   e) What is dehumidification and how is it done?

PART – B
UNIT – I

2. a) What are the factors to be considered in evaluating the performance of an engine? 2 M
   b) A gasoline engine working on four stroke develops a 10 M

brake power of 20.9 kW. Morse test was conducted on this engine and the brake power (kW) obtained when each cylinder was made inoperative by short circuiting the spark plug are 14.9, 14.3, 14.8 and 14.5 KW respectively. The test was conducted at constant speed. Find the indicated power, mechanical efficiency and brake mean effective pressure when all the cylinders are firing. The bore of the engine is 75 mm and the stroke is 90 mm. The engine is running at 3000 rpm.

OR

3. During the trial of a single-cylinder, four-stroke oil engine, the following results were obtained. Cylinder diameter = 20cm, Stroke = 40 cm, Mean effective pressure = 6 bar, Torque = 407 Nm, Speed = 250 rpm, Oil consumption = 4 kg/h, Calorific value of fuel = 43 MJ/kg, Cooling water flow rate = 4.5 kg/min, Air used per kg of fuel = 30 kg, Rise in cooling water temperature = 45^0C, Temperature of exhaust gases = 420^0C, Room temperature = 20^0C, Mean specific heat of exhaust gas = 1 kJ/kg K, Specific heat of water = 4.18 kJ/kg K. Find the IP, BP, and draw up a heat balance sheet for the test in kJ/h. 12 M

UNIT – II

4. a) Distinguish the phenomenon of knocking in SI and CI engines. 4 M

   b) What are the different stages of combustion in SI engines? Explain with p-θ diagram. 8 M

OR

5. a) What is the significance of octane rating and cetane rating in the context of IC engine fuels? 4 M

b) With the help of figures, explain the factors which influence the flame speed in an S.I engine. 8 M

UNIT-III

6. Steam enters the turbine of a Rankine cycle at 2.5 MPa, 300^0 C and, after expansion, is condensed at a pressure of 15 kPa. Determine i) thermal efficiency ii) thermal efficiency if steam is superheated to 500^0 C instead of 300^0 C and iii) thermal efficiency if boiler pressure is raised to 5 MPa while turbine inlet temperature is maintained at 500^0 C. 12 M

OR

7. In a reheat Rankine cycle, Boiler steam pressure and maximum temperature (T_{max}) are 150 bar, 550^0 C respectively. The condenser pressure is 0.1 bar and quality of steam at turbine exhaust is 95%. Assuming ideal processes, estimate i) reheat pressure ii) thermal efficiency of a cycle and iii) steam rate. 12 M

UNIT – IV

8. a) For fixed maximum and minimum temperatures, what is the effect of the pressure ratio on (i) the thermal efficiency and (ii) the net work output of a simple ideal Brayton cycle? 3 M

b) Derive the expression for air-standard efficiency of Brayton cycle with the help of P-V and T-S diagrams. 9 M

OR

9. A gas-turbine power plant operates on the simple Brayton cycle with air as the working fluid and delivers 32 MW of power. The minimum and maximum temperatures in the cycle are 310^0 and 900^0 K, and the pressure of air at the compressor exit is 8 times the value at the compressor inlet. Assuming an isentropic efficiency of 80% for the compressor and 86% for the turbine, determine the mass flow rate of air through the cycle. Account for the variation of specific heats with temperature. 12 M

UNIT – V

10. a) For domestic refrigeration purposes, which type of refrigeration system is preferred and why? 3 M

    b) A Bell Coleman refrigeration cycle with a pressure ratio of 3 uses helium as the working fluid. The temperature of the helium is -10°C at the compressor inlet and 50°C at the turbine inlet. Assuming adiabatic efficiencies of 80% for both the turbine and the compressor, determine (i) the minimum temperature in the cycle, (ii) the coefficient of performance. 9 M

OR

11. a) What is the difference between the specific humidity and the relative humidity? 3 M

    b) A room contains air at 1 atm, 26°C, and 70% relative humidity. Using the psychrometric chart, determine (i) the specific humidity, (ii) the enthalpy (in kJ/kg dry air),(iii) the wet-bulb temperature, (iv) the dew-point temperature, and (v) the specific volume of the air (in m^3/kg dry air). 9 M