

B.Tech. (Sem. - 3rd)**THERMAL ENGINEERING****SUBJECT CODE : PE - 205****Paper ID : [A0204]****[Note : Please fill subject code and paper ID on OMR]****Time : 03 Hours****Maximum Marks : 60****Instruction to Candidates:**

- 1) Section - A is **Compulsory**.
- 2) Attempt any **Four** questions from Section - B.
- 3) Attempt any **Two** questions from Section - C.

Section - A**Q1)****(10 × 2 = 20)**

- a) State zeroth law of thermodynamics.
- b) Define state, process and cycle.
- c) What do you understand by free expansion process.
- d) State clausius statement of second law of thermodynamics.
- e) Why two stroke engine has smaller flywheel than four stroke engine.
- f) Define the term compression ratio and mean effective pressure.
- g) What do you understand by boiler accessories? Write any four boiler accessories.
- h) Define the term specific humidity, relative humidity.
- i) State clausius inequality for reversible and irreversible process.
- j) What do you mean by the term entropy? What are the characteristics of entropy?

Section - B**(4 × 5 = 20)**

- Q2)** When a stationary mass of gas was compressed without friction at constant pressure its initial state of 0.4 m³ and 0.105 MPa was found to change to final state of 0.20 m³ and 0.105 MPa. There was a transfer of 42.5 kJ of heat from the gas during the process. How much did the internal energy of the gas change?

Q3) In a steam plant, 1kg of water per second is supplied to the boiler. The enthalpy and velocity of water entering the boiler are 800 kJ/kg and 5 m/s. The water receives 2200 kJ/kg of heat in the boiler at constant pressure. The steam after passing through the turbine comes out with velocity of 50 m/s and its enthalpy is 2520 kJ/kg. The inlet is 4 m above the turbine exit. Assuming the heat losses from the boiler and the turbine to the surroundings are 20 kJ/s, calculate the power developed by the turbine. Consider the boiler and turbine as single system.

Q4) The atmospheric conditions are; 20°C and specific humidity of 0.0095 kg/kg of dry air. Calculate :

(a) Partial pressure of vapor.

(b) Relative humidity.

(c) Dew point temperature.

Q5) Describe the working of locomotive boiler with neat sketch.

Q6) State the relative advantages and disadvantages of battery and magneto-ignition system.

Section - C

(2 × 10 = 20)

Q7) A fluid undergoes a reversible adiabatic compression from 4 bar, 0.3 m³ to 0.08m³ according to the law, $p v^{1.25} = \text{Constant}$. Determine :

(a) Change in enthalpy.

(b) Change in internal energy.

(c) Change in entropy.

(d) Heat transfer.

(e) Work transfer.

Q8) A four cylinder petrol engine has a bore of 57 mm and a stroke of 90 mm. Its rated speed is 2800 r.p.m and is tested at this speed against a brake, which has a torque arm of 0.356 m. The net brake load is 155 N and fuel consumption is 6.74 litres/hour. The specific gravity of petrol used is 0.735 and it has a lower calorific value of 44200 kJ/kg. A Morse test is carried out and the cylinders are cut out in order 1, 2, 3, 4 with corresponding brake loads 111, 106.5, 104.2 and 111 N, respectively. Calculate for this speed :

- (a) Engine torque.
- (b) Brake mean effective pressure.
- (c) Brake thermal efficiency.
- (d) Specific fuel consumption.
- (e) Mechanical efficiency.
- (f) Indicated mean effective pressure.

Q9) An engine working on Otto cycle has a volume of 0.45m^3 , pressure 1 bar and temperature 30°C at the beginning of compression stroke. At the end of the compression stroke, the pressure is 11 bar. 210 kJ of heat is added at constant volume. Determine :

- (a) Pressure, temperature and volume at the salient points in the cycle.
- (b) Percentage clearance.
- (c) Efficiency.
- (d) Net work per cycle.
- (e) Mean effective pressure.

Assume the cycle is reversible.

