



CBCS SCHEME

17AU33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020 Engineering Thermodynamics

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamic data handbook, steam tables, psychrometry chart allowed.*

Module-1

- 1 a. Differentiate:
- Intensive and Extensive property
 - Macroscopic and Microscopic approach
 - Closed and open system
 - Path function and point function. (08 Marks)
- b. State Zeroth law of Thermodynamics and explain. Thermocouple with test junction at $t^\circ\text{C}$ on a gas thermometer and cold junction at 0°C gives output emf as per the following relation. $e = 0.20t - 5 \times 10^{-4} t^2$ mV. Where 't' is the temperature. The millivoltmeter is calibrated at ice and steam points. What temperature would this thermometer show when gas thermometer reads 70°C . (12 Marks)

OR

- 2 a. Define work and heat from thermodynamics view point. Mention similarities between work and heat. (06 Marks)
- b. Derive an expression for workdone during quasistatic process. (06 Marks)
- c. Explain constant volume gas thermometer with neat sketch. (08 Marks)

Module-2

- 3 a. Explain Joule's experiment. Prove that internal energy is a property of the system. (10 Marks)
- b. 12kg of air per minute is delivered by a centrifugal air compressor. The inlet and outlet conditions of air are $\bar{V}_1 = 12\text{m/s}$, $P_1 = 1$ bar, $V_1 = 0.5\text{m}^3/\text{kg}$ and $\bar{V}_2 = 90\text{m/s}$, $P_2 = 8$ bar, $V_2 = 0.14\text{m}^3/\text{kg}$. The increase in enthalpy of air passing through the compressor is 150kJ/kg and heat loss to the surrounding is 700kJ/min . Calculate:
- Power required to drive the compressor
 - Ratio of inlet to outlet pipe diameter. (10 Marks)

OR

- 4 a. Define available and unavailable energy. (04 Marks)
- b. Prove that entropy is a property of a system. (08 Marks)
- c. Derive Clausius inequality. (08 Marks)

Module-3

- 5 a. Define:
- Air-fuel ratio
 - Excess air
 - Stoichiometric air
 - Enthalpy of combustion
 - Calorific value. (10 Marks)

- b. A 4 stroke, 4 cylinder petrol engine was tested at full throttle at constant speed. The cylinders have diameters of 80mm and stroke 100mm, fuel was supplied at the rate of 5.44 kg/hr and the plugs of the four cylinders were successively short circuited without the change of speed. The power measured was as follows:

With all cylinders working – 14.7 kW

With cylinder 1 cut off – 10.1 kW

With cylinder 2 cut off – 10.3 kW

With cylinder 3 cut off – 10.4 kW

With cylinder 4 cut off – 10.2 kW

Calorific value of the fuel used was 41900 kJ/kg. The clearance volume of each cylinder is 100CC. Determine: i) The mechanical efficiency ii) The indicated thermal efficiency
iii) The air standard efficiency. (10 Marks)

OR

- 6 a. Derive the expression for thermal efficiency and mean effective pressure for Diesel cycle. (10 Marks)
- b. During a test on a single cylinder 4 stroke cycle oil engine the following data and results were obtained. MEP = 5.6bar, swept volume = 14 litres, speed = 6.6RPS, load = 0.75kN, radius of brake drum = 0.7m, fuel consumption = 0.002kg/s, calorific value of fuel = 46000kJ/kg, cooling water circulation = 0.15kg/s, Temperature rise of cooling water = 33°C. Determine:
- Brake power
 - Indicated power
 - Indicated thermal efficiency.
- Also draw heat balance sheet on minute basis. (10 Marks)

Module-4

- 7 a. What is refrigeration? With neat diagram explain steam jet refrigeration system. (10 Marks)
- b. Atmospheric air at 76cm of Hg barometric pressure has 25°C DBT and 15°C WBT. With help of psychrometric table, Determine:
- The relative humidity
 - The humidity ratio
 - The dew point temperature
 - The enthalpy of air per kg of dry air
 - The partial pressure of vapour. (10 Marks)

OR

- 8 a. Explain winter air conditioning system with the help of schematic diagram. (08 Marks)
- b. A hall is to be air conditioned for 100 persons requiring 0.5m³/minute/person. Outdoor conditions: 35°C DBT, 65% RH
Required conditions: 15°C DBT, 40% RH
The required conditions are achieved first by cooling and dehumidification and then by heating. Find: i) Capacity of the humidifier ii) Cooling coil capacity iii) Heating coil capacity. (12 Marks)

Module-5

- 9 a. Derive the expression for the isothermal work done by a reciprocating compressor of a single stage, neglecting clearance volume. (10 Marks)
- b. What do you understand by multistage air compressor? Mention the advantages of multistage air compression. (10 Marks)

OR

- 10 a. Explain various types of constant pressure gas turbines with neat sketch. (10 Marks)
- b. With a neat sketch, explain i) Turbojet engine ii) Rocket propulsion. (10 Marks)
