

THERMODYNAMICS
(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

PART – A
(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- What is a pure substance?
 - What is an irreversible process? Give examples.
 - What is PPM1?
 - Write difference between non-flow process and steady flow process.
 - State Kelvin-Planck statement.
 - What do you mean by irreversibility of the process?
 - Write Clausius Clapeyron equation and its significance.
 - Define p-v-T surface and state its significance.
 - State Gibb's-Dalton law.
 - What is an air-standard efficiency and relative efficiency of gas power cycle?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- 2 (a) Explain briefly Zeroth law of thermodynamics.
(b) A fluid at a pressure of 3 bar and with specific volume of $0.18 \text{ m}^3/\text{kg}$, contained in a cylinder behind a piston expands reversibly to a pressure of 0.6 bar according to a law, $p = (C/v^2)$ where C is a constant. Calculate the work done by the fluid on the piston.

OR

- 3 (a) Compare macroscopic and microscopic approaches in thermodynamic studies.
(b) Explain about point function and path function with examples.

UNIT – II

- 4 Write down the general equation for steady flow systems and simplify when applied for the following systems:
- Steam turbine.
 - Steam nozzle.
 - Centrifugal compressor.
 - Condenser.

OR

- 5 At the inlet to a certain nozzle the enthalpy of fluid passing is 2800 kJ/kg and velocity is 50 m/s . At the discharge end the enthalpy is 2600 kJ/kg . The nozzle is horizontal and there is negligible heat loss from it.
- Find the velocity at exit of the nozzle.
 - If the inlet area is 900 cm^2 and specific volume at inlet is $0.187 \text{ m}^3/\text{kg}$, find mass flow rate.
 - If the specific volume at the nozzle exit is $0.498 \text{ m}^3/\text{kg}$, find the exit area of the nozzle.

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UNIT – III

- 6 (a) Explain in detail about Clausius inequality.
(b) 1 kg of air initially at 8 bar pressure and 380 K expands polytropically ($pv^{1.2} = \text{constant}$) until the pressure is reduced to one-fifth value. Calculate: (i) Final specific volume and temperature. (ii) Change of entropy, work done and heat interaction. (iii) Change in entropy.

OR

- 7 (a) Prove that entropy is a property of a system.
(b) 5 kg of air at 550 K and 4 bar is enclosed in a closed system.
(i) Determine the availability of the system if the surrounding pressure and temperature are 1 bar and 290 K respectively.
(ii) If the air is cooled at constant pressure to the atmospheric temperature, determine the availability.

UNIT – IV

- 8 Derive the Maxwell relations.

OR

- 9 (a) Explain about compressibility charts.
(b) A pressure cooker contains 1.5 kg of saturated steam at 5 bar. Find the quantity of heat which must be rejected so as to reduce the quality to 60% dry. Determine the pressure and temperature of the steam at the new state.

UNIT – V

- 10 (a) Explain about adiabatic mixing of perfect gases.
(b) A mixture of hydrogen (H_2) and oxygen (O_2) is to be made so that ratio of H_2 to O_2 is 2:1 by volume. If the pressure and temperature are 1 bar and 25°C respectively, calculate: (i) The mass of O_2 required. (ii) The volume of the container.

OR

- 11 (a) Derive expression for air standard efficiency of Otto cycle.
(b) The stroke and cylinder diameter of a compressor ignition engine are 250 mm and 150 mm respectively. If the clearance volume is 0.0004 m^3 and fuel injection takes place at constant pressure for 5 percent of the stroke, determine the efficiency of the engine. Assume engine is working on diesel cycle.
