SE SEM III (NEP 2020) Mechanical Dec 2025
QP code - 00372 Date - 8/12/2025

Duration – 2hours **Marks – 60**

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N.B. (1) Question 1 is **Compulsory**
(2) Attempt any Three out of remaining five.
(3) All questions carry equal marks
(4) Assume suitable data, if necessary and state it clearly.
(5) Use of Steam Table is permitted.

Q 1 Solve **any FIVE** **[15]**

a) State Zeroth Law of thermodynamics and give its significance.

b) State two statements of Second law of thermodynamics

c) State Maxwell equations.

d) Explain the Point and Path functions with suitable examples.

e) Draw p-V and T-S diagram of Strirling Cycle

f) Explain in brief Sonic velocity and Mach number for Compressible fluid flow.

Q 2 a) 1 m^3 of an ideal gas at 300 K and 1 bar is compressed adiabatically to 12 bar. It is then cooled at constant volume and further expanded isothermally so as to reach the condition from where it started. **[10]**
Calculate: (i) Pressure at the end of constant volume cooling.
(ii) Change in Internal Energy
(ii) Net work done and heat transferred during the cycle.
Assume - $C_p = 14.3$ kJ/kg K and $C_v = 10.2$ kJ/kg K

b) EXplain why entropy is a property of a system **[05]**

Q 3 a) A reversible heat engine operates between two reservoirs at temperatures 700°C and 50°C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 50°C and –25°C. The heat transfer to the engine is 2500 kJ and the net work output of the combined engine refrigerator plant is 400 kJ. **[08]**
Determine the heat transfer to the refrigerant and the net heat transfer to the reservoir at 50°C;

b) Derive Steady flow energy equation. Apply it to Steam Turbine. **[07]**

Q 4 a) Steam at 20 bar, 360°C is expanded in a steam turbine to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assuming ideal processes, Find the net work done per kg of steam and the cycle efficiency. **[08]**

b) Explain the Phase change process of water with diagram. **[07]**

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Q 5 a) An engine with 200 mm cylinder diameter and 300 mm stroke works on theoretical Diesel cycle. The initial pressure and temperature of air used are 1 bar and 27°C.The cut-off is 8% of the stroke. Determine : **[10]**
(i) Pressures and temperatures at all salient points.
(ii) Theoretical air standard efficiency.

Take $C_p = 1.005$ kJ/kgK, $C_v = 0.718$ kJ/kgK, and $R = 0.287\ kJ/kgK$ for air.

b) Explain Heat engine, Heat Pump and Refrigerator **[05]**

Q 6 Attempt **Any Three** **[15]**

a) Sketch simple steam power plant and explain its main components in short.

b) Explain – Availability, Irreversibility and Dead State.

c) State the assumptions made in air standard otto cycle.

d) Define – Stochiometric Air-Fuel Ratio, Enthalpy of formation, Calorific Value, Adiabatic flame temperature.

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