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8. (a) Derive the equations for the estimation of vacuum efficiency and condenser efficiency.

(b) Find the weight of cooling water required in the surface condenser of 3000kw steam power plant with the following data. Steam used = 10 kg/kwhr; Exhaust steam condition = 0.9 dry; pressure in the condenser = 0.1 bar; Hot well temperature = 32°C; cooling water inlet temperature = 25 °C; cooling water outlet temperature = 32 °C; temperature of steam at entrance 40°C. And also calculate the vacuum efficiency.

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[03 – 2113]

II/IV B.E. DEGREE EXAMINATION.

First Semester

Mechanical Engineering

ENGINEERING THERMODYNAMICS — I

(Common with M.S. Mechanical Engineering)

(Effective from the admitted batch of 2006–2007)

Time : Three hours Maximum : *70 marks*

First questions is compulsory.

Answer any FOUR from the remaining.

All questions carry equal marks.

Use of "gas tables" is permitted.

1. (a) What do you mean by thermodynamic equilibrium?

(b) Write down the sign conventions of heat and work in thermodynamics.

(c) State Zeroth law of thermodynamics.

(d) What are the various limitations of thermodynamics?

(e) Why A carnot's engine cannot be realised in actual practice?

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(f) What are the various applications of Boltzmann equation?

(g) State the Second law of thermodynamics. Also write its physical significance.

2. (a) What is a thermodynamic system? What is the difference between a closed system and an open system? Give few examples for closed and open systems.

(b) Explain the terms state, path, process and cyclic process.

(c) Differentiate between Homogeneous and Heterogeneous systems.

3. (a) State the limitations of first law of thermodynamics.

(b) A mass of gas is compressed in a quasi- static process from 85k pa, $0.1m^3$. Assume that the pressures, volumes are related by PV^n = constant, find net work done by gas system.

4. (a) An engine operating on a Carnot cycle works with in temperature limits of 600 K and 300K. If the engine receives 2000 KJ of heat, evaluate the work done and thermal efficiency of the engine.

(b) Explain the following

(i) Gibb's free energy

(ii) Helmholtz function

5. (a) In a regenerative cycle the inlet conditions are 40 bar and 400oC. Steam is bled at 10 bar in regenerative heating. The exit pressure is 0.8 bar. Neglecting pump work, determine the efficiency of the cycle.

(b) What is compounding? Describe various ways of compounding impulse turbines and give their merits and demerits.

6. (a) What are the various losses generally occur in a steam turbine?

(b) The outlet area of a nozzle in a simple impulse turbine is 15cm and steam leaves the nozzle at 1.4 bar, 0.9 dry and with a velocity 650 m/s. The nozzles are inclined at 20° to the plane of the wheel, the blade speed is 250 m/s, the blade exit angle is 30° and the blade velocity coefficient is 0.8. Estimate the power developed and steam consumption per kilowatt - hour.

7. (a) What do you mean by choked flow in nozzles?

(b) Steam at 10 bar and 0.96 dryness fraction is to be discharged at a rate of 100 kg/hr through a convergent divergent nozzle to a back pressure of 1.4 bar, Find suitable diameters for throat and exit assuming 10% of the overall isentropic enthalpy drop reheats the steam in the divergent portion of the nozzle.