

C 31898

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Name

Reg. No.

**FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION
JUNE 2007**

EE 2K 403—MECHANICAL ENGINEERING—III

Time : Three Hours

Maximum : 100 Marks

(Use of Heat and Mass Transfer Data Book is permitted).

Answer all questions.

- I. (a) Define bulk modulus of elasticity and vapor pressure.
(b) Explain a differential manometer.
(c) Define the hydraulic efficiency and overall efficiency of a hydraulic turbine.
(d) Explain the coefficient of discharge and negative slip for a reciprocating pump.
(e) What is critical radius of insulation? Derive an expression for the critical radius of insulation of a sphere.
(f) Distinguish between fin efficiency and fin effectiveness. Explain.
(g) Define specific humidity, relative humidity and degree of saturation.
(h) Explain the capacity factor and diversity factor.

(8 × 5 = 40 marks)

- II. (a) Consider a thrust bearing which consists of a 10 cm diameter pad rotating on another pad. The pads are separated by an oil film (viscosity = 0.08 Pa.s) by 1.5 mm. If the bearing rotates at 100 rpm, determine the power dissipated in the bearing.

Or

- (b) A solid hemisphere of density ρ and radius r floats with its plane base immersed in a liquid of density ρ_1 ($\rho_1 > \rho$). Show that the equilibrium is stable and the metacentric height is

$$\frac{3}{8}r \left(\frac{\rho_1}{\rho} - 1 \right).$$

- III. (a) A Pelton wheel works under a net head of 310 m. The speed is 560 rpm and the power developed is 5890 kW. The turbine has an overall efficiency of 80%. The ratio of the jet diameter and the mean bucket circle diameter is 1:10. Find the following :

- (i) Number of jets and their diameter.
(ii) The diameter of the wheel and the discharge.

Assume $C_v = 0.97$ and bucket speed = 0.47 times jet speed.

Or

- (b) With a neat sketch, explain briefly a centrifugal pump and its components.

- IV. (a) Derive the general 3-D heat conduction equation in cylindrical coordinates. State the assumptions made.

Or

Turn over

- (b) Obtain an expression for the temperature profile and heat transfer from an infinitely long fin from first principles.

V. (a) (i) What are the processes needed for Air-Conditioning cycle for hot and wet climate? Draw the schematic diagram and indicate the processes on psychrometric chart.

(12 marks)

- (ii) What is the difference between central AC and package AC?

(3 marks)

Or

- (b) A power plant of 210 MW installed capacity has the following particulars :

Capital cost = Rs 18,000/kW installed.

Interest and depreciation = 12 %

Annual load factor = 60%

Annual capacity factor = 54%

Annual running charges = Rs 200 * 10⁶

Energy consumed by power plant auxiliaries = 6%

Calculate the cost of power generation per kWh and the reserve capacity.

(4 × 15 = 60 marks)