CBCS Scheme

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Fourth Semester B.E. Degree Examination, June/July 2018
Fluid Mechanics & Machines

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. Define specific weight, specific gravity and surface tension. **(06 Marks)**

b. Derive an expression for capillary rise. **(06 Marks)**

c. The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 Poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. **(04 Marks)**

OR

2 a. State and prove hydrostatic law. **(07 Marks)**

b. Define Total Pressure and centre of pressure. **(03 Marks)**

c. A differential manometer is connected at the two points A and B of two pipes as shown in Fig. Q2 (c). The pipe A contains a liquid of specific gravity 1.5, while pipe B contains a liquid of specific gravity 0.9. The pressures at A and B are 1 kgf/cm^2 and 1.80 kgf/cm^2 respectively. Find the difference in mercury level in differential monometer. **(06 Marks)**

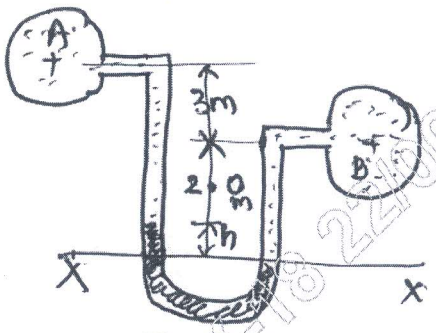

Fig. Q2 (c)

Module-2

3 a. Derive continuity equation in 3-dimensions. **(08 Marks)**

b. Define velocity potential function and stream function. **(04 Marks)**

c. The stream function for a two-dimensional flow is given by $\psi = 2xy$. Calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ. **(04 Marks)**

OR

4 a. Derive Euler's equation of motion for Ideal fluids and hence deduce Bernoulli's equation. Also state the assumptions made in the derivation of Bernoulli's equation. **(10 Marks)**

b. A pipe of diameter 400 mm carries water at a velocity of 25 m/s. The pressures at the points A and B are given as 29.43 N/cm^2 and 22.563 N/cm^2 respectively, while the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B. **(06 Marks)**

Module-3

5 a. State Buckingham π theorem and briefly explain it. **(04 Marks)**

b. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by,

$$T = D^5 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho}\right]$$

Prove this by Buckingham Pi(π) theorem. **(08 Marks)**

c. Define dimensional homogeneity. **(04 Marks)**

OR

6 a. Derive an expression for discharge through venturimeter. **(10 Marks)**

b. A horizontal venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and throat is 20 cm of mercury. Determine the rate of flow. Take $C_d = 0.98$. **(06 Marks)**

Module-4

7 a. Define turbo machine. With neat sketches briefly explain axial and radial flow hydraulic turbine. **(08 Marks)**

b. Derive the Euler's energy equation for a general turbomachine. **(08 Marks)**

OR

8 a. Obtain an expression as shown below for energy transfer E as a function of discharge blade angle β_2 for a turbo machine. Make the following assumptions : (i) $v_2 = 2v_1$ (ii) Constant radial velocity (iii) No inlet angular momentum and inlet blade angle = 45°.
The expression is,

$$E = 2V_{f_2}^2 \left[\cot\beta_2 - 2\right]$$

(10 Marks)

b. Briefly explain the nature of energy transfer and the relative values in pair terms of an alternate form of Euler's turbine equation. **(06 Marks)**

Module-5

9 a. A Delton wheel has a tangential velocity of buckets 15 m/s. The water is being supplied under a head of 36 m at the rate of 0.02 m^3/s. The bucket deflects the jet through an angle of 160°. If the coefficient of the velocity for the nozzle is 0.98. Find the power developed by the wheel. **(10 Marks)**

b. Briefly explain the functions of a draft tube. **(06 Marks)**

OR

10 a. Briefly explain,
(i) Velocity compounding at Impulse turbine.
(ii) Pressure compounding of Impulse turbine. **(10 Marks)**

b. Explain : (i) Stage efficiency (ii) Blade efficiency (iii) Nozzle velocity coefficient. **(06 Marks)**

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