CBCS Scheme

USN | | | | | | | | | | 15MT42

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Fluid Mechanics and Machines

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define: (i) Density (ii) Specific volume (iii) Specific gravity (iv) Kinematic viscosity (v) Capillarity **(05 Marks)**

b. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size $0.8m \times 0.8m$ and an inclined plane with angle of inclination 30°. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm. **(05 Marks)**

c. Determine an expression for surface tension on a water droplet and liquid jet. **(06 Marks)**

OR

2 a. Derive an expression for total pressure and centre of pressure for a vertical plane submerged in liquid. **(08 Marks)**

b. Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water such a way that the centre of plate is 3 m below the free surface of water. Also find the position of centre of pressure. **(05 Marks)**

c. Define (i) Gauge pressure (ii) Vacuum pressure (iii) Absolute pressure **(03 Marks)**

Module-2

3 a. Derive continuity equation in Cartesian co-ordinates in three dimensions. **(08 Marks)**

b. If for a two dimensional potential flow, the velocity potential is given by $\phi = x(2y-1)$. Determine the velocity at point P(4, 5). Also determine value of stream function ψ at point P. **(08 Marks)**

OR

4 a. Derive Euler's equation of motion for ideal fluids and hence deduce Bernoulli's equation. **(10 Marks)**

b. Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40 litres/sec. **(06 Marks)**

Module-3

5 a. Explain in brief about the following dimensionless numbers : (i) Reynold's number (ii) Euler's number (iii) Mach number. **(06 Marks)**

b. The efficiency η of a fan depends on density ρ dynamic viscosity μ of the fluid, angular velocity ω diameter D of the rotor and the discharge Q. Express η interms of dimensionless parameters. **(10 Marks)**

OR

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

b. An orificemeter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orificemeter gives readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Coefficient of discharge for the meter is given as 0.6. Find the discharge of water through pipe. **(06 Marks)**

Module-4

7 a. Define turbo machine. With a neat sketch, explain the principal components of turbomachine. **(08 Marks)**

b. Define degree of reaction. Show that $S = \frac{R}{(1-R)}.D$

Where, S = Static component of energy transfer
D = Dynamic components of energy transfer in any turbomachine.
R = Degree of reaction **(08 Marks)**

OR

8 a. Distinguish between a turbomachine and a positive displacement machine. **(06 Marks)**

b. Derive an alternative form of Euler's turbine equation and explain the significance of each energy components. **(10 Marks)**

Module-5

9 a. In a Franci's turbine, the discharge of fluid is radial. The blade speed at inlet = 25 m/s and the tangential component of velocity = 18 m/s. The radial velocity of flow is constant and equal to 2.5 m/s. Water flows at the rate of 0.8 m^3/s. The utilization factor is 0.82. Find
(i) Euler's head (ii) Power developed (iii) Inlet blade angle
(iv) Degree of reaction (R).
Also draw the velocity triangles. **(10 Marks)**

b. Briefly explain the different types of draft tubes. **(06 Marks)**

OR

10 a. For a single stage impulse turbine, prove that the maximum blade efficiency is given by, $(\eta_b)_{max} = \frac{\cos^2 \alpha_1}{2}(1+KC)$, where $K = \frac{V_{r_2}}{V_{r_1}}$ and $C = \frac{\cos\beta_2}{\cos\beta_1}$, α_1 = nozzle angle,

β_1 and β_2 = Rotating blade angles at inlet and exit.

V_{r_1} and V_{r_2} = Relative velocities at inlet and exit. **(08 Marks)**

b. What is compounding of steam turbine? Explain with the help of a schematic diagram a two row velocity compounded impulse turbine stage. **(08 Marks)**

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