CBCS SCHEME

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17AE/AS35

Third Semester B.E. Degree Examination, June/July 2019
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. If the velocity profile of a fluid over a plate is Parabolic with the vertex 20cm from the plate, where the velocity is 120 cm/sec. calculate the velocity gradients and shear stresses at a distance of 0, 10 and 20cm from the plate, if the viscosity of the fluid is 8.5 poise. **(10 Marks)**

b. An oil of viscosity 5 Poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5m and it rotates at 200rpm. Calculate the power lost in oil for a sleeve length of 100mm. The thickness of oil film is 1.0 mm. **(05 Marks)**

c. VTU is paying Rs. 6.55/kWh for electric power. To reduce its power bill. The VTU installs a wind turbine with a rated power of 30kW. If the turbine operates 2200 hour per year at the rated power, determine the amount of electric power generated the wind turbine and the money saved by the VTU per year. **(05 Marks)**

OR

2 a. Derive an expression for the force exerted and center of pressure for a completely submerged inclined plane surface. **(10 Marks)**

b. Derive an expression for the force exerted and centre pressure for a completely submerged curved plane surface. **(10 Marks)**

Module-2

3 a. Derive stream function and potential function for Doublet flow. Discuss plotting of stream lines and potential lines. **(10 Marks)**

b. Derive steam function and potential function for source flow. Discuss plotting of stream lines and potential lines. **(10 Marks)**

OR

4 a. Two discs are placed in a horizontal plane, one over the other. The water enters at the centre of the lower disc and flows radially outward from a source of strength 0.628 m/s. The pressure at a radius 50mm, is 200kN/m^2. Predict

i) Pressure in kN/m^2 at a radius of 500mm

ii) Stream function at angles of 30° and 60° if $\psi = 0$ at $\theta = 0°$. **(10 Marks)**

b. Derive Navier – Stokes equation using control volume approach. **(10 Marks)**

Module-3

5 a. Derive expression for rate of flow through venturimeter. **(10 Marks)**

b. Derive expression for rate of flow through orifice meter or orifice plate. **(10 Marks)**

OR

6 a. The pressure difference ΔP in a pipe of diameter D and length ℓ due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness K. using Buckingham's π theorem, obtain on expression for ΔP. **(10 Marks)**

b. Using Buckingham's π-theorem show that the discharge Q consumed by an oil ring is given by $Q = Nd^3\phi\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{\rho N^2 d^3}, \frac{\omega}{\rho N^2 d}\right]$

Where d is the internal diameter of the ring, N is rotational speed ρ is density, μ is viscosity, σ is surface tension and ω is the specific weight of oil. **(10 Marks)**

Module-4

7 a. Derive Von Karman momentum integral equation for boundary layer flows. **(12 Marks)**

b. With a neat sketch, explain the effect of pressure Gradient on boundary layer separation. **(08 Marks)**

OR

8 Explain boundary layer flow concept and derive Displacement thickness (δ^*), momentum thickness (θ) and energy thickness (δ^{**}) **(20 Marks)**

Module-5

9 a. Obtain the expression for force exerted by a flowing fluid on a stationary body. **(10 Marks)**

b. Derive Bernoulli's equation for isothermal process and Adiabatic process. **(10 Marks)**

OR

10 a. Obtain the expression for velocity of sound or pressure wave in a fluid. **(10 Marks)**

b. Describe propagation of pressure waves (or Disturbance) in a compressible fluid. **(10 Marks)**

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