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Question Paper Code:R3105

B.E./B.Tech. DEGREE EXAMINATION, NOV 2025

Third Semester

R21UCE305 - FLUID MECHANICS

Civil Engineering

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

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| 1. What is a fluid? How are fluids classified? | CO1- U |
| 2. State Newton's law of Viscosity. | CO1- U |
| 3. What are the assumptions made in deriving Bernoulli's equation? | CO2- App |
| 4. List the different types of flow. | CO1- U |
| 5. State Buckingham's π theorem. | CO1- U |
| 6. List the types of similarities between model and prototype. | CO1- U |
| 7. Define critical velocity | CO1- U |
| 8. What is hydraulic mean depth | CO1- U |
| 9. What are the different methods of preventing the separation of boundary layers? | CO1- U |
| 10. Define the terms: Drag and lift | CO1- U |

PART – B (5 x 16= 80 Marks)

11. (a) The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 5.5 poise. The shaft is of diameter 0.35 m and rotates at 220 rpm. Calculate the power lost in the bearing for a sleeve length of 100 mm. The thickness of the oil film is 2 mm. CO2- App (16)

Or

- (b) Two large plane surfaces are 3.0 cm apart. The space between the surfaces is filled with castor oil. What force is required to drag a very thin plate of surface area 0.6 m² between the large plate surfaces at a speed of 0.8 m/s if: (i) The thin plate is in the middle of the two plane surfaces. (ii) The thin plate is at 1.2 cm from one of the plane surfaces. Use μ of castor oil = 0.75 Ns/m². CO2 - App (16)
12. (a) If for a two – dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$ determine the velocity at the point P(4,5). Determine also the value of stream function Ψ at the point P. CO2 - App (16)
- Or
- (b) A horizontal Venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the rate of flow of water. The pressure at inlet is 17.658 N/cm² and the vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. CO2 - App (16)
13. (a) Find the expression for the power P, developed by a pump when P depends upon the head H, the discharge Q and specific weight w of the fluid. Use Rayleigh's Method. CO2- App (16)
- Or
- (b) The resisting force (R) of a supersonic flight can be considered as dependent upon length of aircraft (l), velocity (V), air viscosity " μ ", air density " ρ ", and bulk modulus of air " k ". State the functional relationship between these variables and the resisting force. CO2- App (16)
14. (a) A water main's diameter unexpectedly increased from 200mm to 450mm, with a 10mm hydraulic gradient. Compute the flow rate. CO2 - App (16)
- Or
- (b) A main pipe divides into two parallel pipes which again forms one pipe the length and diameter for the first parallel pipe are 2000 m and 1 m respectively, while the length and diameter of second parallel pipe are 2000 m and 0.8 m. Calculate the rate of flow in each parallel pipe, if the total flow in the main is 3 m³/s. the coefficient of friction for each parallel pipe is same and equal to 0.005. CO2 - App (16)

15. (a) A trailing edge of smooth plate of length 6 m and of width 2.5 m, CO2 - App (16)
when the plate is moving with a velocity of 5 m/s in stationary
air. Determine the total drag on one side of the plate assuming
that i) the boundary layer is laminar over the entire length of the
plate and ii) the boundary layer is turbulent from the very
beginning. Take kinematic viscosity = $2.5 \times 10^{-5} \text{ m}^2/\text{s}$, Density of
air = 2.226 kg/m^3

Or

- (b) A flat plate 1.5m X 1.5m moves at 50km/hr in stationary air of CO2 - App (16)
density 1.15 kg/m^3 . If the coefficient of drag and lift are 0.15 and
0.75 respectively. Determine the lift force, drag force, resultant
force and the power required to keep the plate in motion

