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Total No. of Questions : 09] [Total No. of Pages : 03

B.Tech. (Sem. - 4th)

FLUID MECHANICS - I

SUBJECT CODE : ME - 206

Paper ID : [A0810]

[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section - A

Q1) *(10 × 2 = 20)*

a) Explain the concept of hydrostatic paradox.

b) Distinguish between surface tension and capillarity.

c) State and explain the term floatation.

d) Differentiate between Eulerian and Lagrangian method of representing fluid motion.

e) Define a weir and point out the difference between notch and weir.

f) Define and distinguish between rotational and irrational flow.

g) Define the term Reynold number, Froude number and Weber number.

h) Can two streamline intersect with each other. Explain.

i) State Pascal's law. Give an example where this principle is applied.

j) What are the Hydraulic gradient and energy gradient lines?

Section - B

(4 × 5 = 20)

Q2) A rectangular plate 3m × 5m is immersed vertically in water such that the 3m slide is parallel to the water surface. Determine the hydrostatic force and center of pressure if the top edge of the surface is :

(a) Flush with the water surface.

(b) 2m below the water surface. Comment the results.

Q3) A wooden cylinder (Specific gravity = 0.6) of circular cross section having length l and diameter d floats in water. Find the maximum permissible l/d ratio so that the cylinder may float in stable equilibrium with its axis vertical. What would be the cylinder length if it is 25cm in diameter.

Q4) A two dimensional flow is described by the velocity components :

$u = 5x^3$ and $v = -15x^2y$

Evaluate the stream function, velocity and acceleration at point P(x = 1m and y = 2m).

Q5) A 2m long pipeline tapers uniformly from 10cm diameter to 20cm diameter at its upper end. The pipe center line slopes upwards at an angle of 30° to the horizontal and the flow direction is from smaller to bigger cross-section. If the pressure gauges installed at the lower ends of the pipeline read 200kPa and 230kPa respectively, determine the flow rate and the fluid pressure at the mid-length of the pipeline. Assume no energy losses.

Q6) A right circular cylinder of radius R and height H is open at the top and completely filled with liquid. At what speed must it rotate in order that the effect of rotation will be to discharge just sufficient quantity of water to expose half of the circular area at the bottom.

Section - C

(2 × 10 = 20)

Q7) A horizontal pipe of 5cm diameter conveys an oil of specific gravity 0.9 and dynamic viscosity 0.8kg/ms. Measurements indicate a pressure drop of 20kN/m^2 per metre of pipe length traversed. Make calculations for the

(a) Flow rate of oil and center line velocity.

(b) Wall shear stress and the frictional drag over 100m of pipe length.

(c) Power of pump required assuming an overall efficiency of 60%.

(d) The velocity and shear stress at 1cm from the pipe surface.

Q8) A circular pipe of radius R1 is placed concentrically inside another pipe of radius R2. If the flow in annular space between the pipes is laminar, show that the maximum velocity occurs at radius 'r' is given by

$$r^2 = (R_2^2 - R_1^2) / [2 \ln(R_2/R_1)].$$

Q9) Explain the principle of venturimeter with neat sketch and establish an expression for the rate of flow through it.

In 100m diameter horizontal pipe, a venturimeter of 0.5 contraction ratio has been fitted. The head of water on the meter when there is no flow is 3m(gauge). Find the rate of flow for which the throat pressure will be 2m of water absolute discharge coefficient for the meter is 0.97.

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