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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) Define compressibility?

b) What is Mach number and its importance?

c) What is meant by turbulence? How does it affect flow properties.

d) Define streamline, streakline, pathline, streamtube.

e) What are the advantages of triangular notch over rectangular notch?

f) Define the term metacentric height and buoyancy.

g) Distinguish uniform and nonuniform flow.

h) Define the term steam function and potential function.

i) What is meant by intensity of pressure? How it varies with the depth of fluid.

j) State the term vorticity, linear strain rate.

Section - B

(4 × 5 = 20)

Q2) A 20cm diameter,60 cm high vertical cylindrical container is filled with 50 cm high fluid whose density is $850kg/m^3$. Now the cylinder is rotated at constant speed. Determine the rotational speed at which the liquid will start spilling from the edges of the container.

Q3) A cube of side 'a' and relative density 's' floats in water. Determine the conditions for its stability if it is given an angular tilt.

Q4) Water flows through a pipe AB 1.2m diameter at 3m/s and then passes through a pipe BC 1.5 diameter. At C, the pipe branches. Branch CD is 0.8m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, velocity in BC, velocity in CD and diameter of CE.

Q5) The rate of water through a vertical conical draft tube of Kaplan turbine is $17.5m^3/s$. The diameter of the draft tube on the side connected to the outer of the turbine runner is 2.5m and average velocity at exist is 1.5m/s. If the pressure at inlet to the tube is not to be less than -0.7 bar, how far the tube should extend above the tail race. Neglect frictional effects and presume that exit of the draft tube lies 1.2~~m below~~ the tail water level.

Q6) A U-tube manometer 15cm high and the limbs at 8cm apart is filled with liquid to height of 10cm in each limb. The manometer is mounted on a large rotating disc such that both the limbs are in the same radial plane,i.e., on the same side of the axis of rotation. Find the position of manometer on the disc if the liquid just spills out when the disc has an angular velocity of 60 rpm.

Section - C

(2 × 10 = 20)

Q7) A fluid possessing viscosity μ and density ρ is flowing through a right circular tube of radius R such that velocity u in axial direction at any radius r is given by:

$$u = 1/4\mu(dp/dx)(R^2 - r^2)$$

For such a flow Reynold number based on average velocity was 300, diameter of the tube was 3cm and length of the pipe was 200m. Determine the pressure difference across the ends of the tube. It may be presumed that the fluid has density $900kg/m^3$ and dynamic viscosity .013 kg/ms.

Q8) For turbulent flow on pipe of 25 cm diameter, the centerline velocity is 2.25m/s and velocity at a point 8 cm from the center as measured by a pitot tube is 1.95m/s.make calculations for

a) friction velocity and wall shear stress.

b) average velocity and discharge through the pipe.

c) friction factor.

d) pipe roughness.

Q9) Sketch and describe a pitot-static probe and explain how it is used to measure the fluid flow through a pipeline. A pitot-static tube having coefficient of 0.98 is used to measure velocity of water in the pipe. The stagnation and static pressures as recorded by the tube are 3m and 2m respectively. What velocity does these measurements indicate?

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