INDIAN MARITIME UNIVERSITY

Time Bound Assignment September/October 2020

B Tech (ME) Arrear Examinations

Fluid Mechanics-I
UG11T3405

Date: 28/09/2020	Maximum Marks: 70
Time: 3 Hrs	Pass Marks: 35

Part – A (compulsory)
Answer the following (10x2=20 Marks)

1. What is surface tension? Which will have more surface tension:- cold or hot water?

2. What is Pascal law? When a balloon is inflated where do you think the air pressure is higher:– inside or outside?

3. Define Total pressure and Center of pressure.

4. Explain the term Meta center and Metacentric height.

5. A flow of water comes through a nozzle and hits a target, delivering a force 'F'. If the diameter of the nozzle is decreased by a factor of two, and the mass flow rate remains constant, what will be the new force on the target?

6. State Bernoulli's theorem for steady flow of an incompressible fluid.

7. Give the detail classification of energy losses in pipes.

8. Water flows over a 1 m long flat plate at 0.01 m/s velocity. Show whether the flow is laminar or turbulent. (Take viscosity 0.001 Pa.s).

9. Draw the following sketches across a section of a pipe, when the flow is viscous: **i.** Velocity distribution **ii.** Shear stress distribution

10. What is a vortex flow? What type of flow is the whirlpool in a river?

Part – B
Answer any 5 out of 7 questions (5 x 10= 50 marks)

11. The end gates of a lock are 9 m high and when closed include an angle of 120^{o}. The width of the lock is 10 m. Each gate is supported by two

hinges located at 1 m and 6 m above the bottom of the lock. The depths of water on the two sides are 8 m and 4 m respectively. Considering the reaction of the gate acting in the same horizontal plane as resultant water pressure, calculate the force on each hinge. **(10 marks)**

12. Derive the expression for Bernoulli's equation from first principle.
A large tank open to the atmosphere is filled with water to a height of 'H' m from the outlet tap. The outlet tap, near the bottom of the tank is now opened, and water flows out from the smooth and rounded outlet. Apply Bernoulli's equation and evaluate the water velocity at the outlet. **(10 marks)**

13. **a.** Measurements in a turbulent boundary layer show a velocity (u) profile that fits the following function, with a boundary layer thickness δ. Take Reynolds Number Re=667000. Calculate the shear stress at the wall at a location x=1 m from the leading edge. Comment is this a good curve fit? U_o= Upstream velocity (constant).

Use $\frac{u}{U_o} = [(\frac{y}{\delta})]^{1/7}$ where $\delta = \frac{0.16\,x}{(Re)^{1/7}}$ **(5 marks)**

b. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and height of the fluid in the left limb from the center of the pipe is 15 cm below. **(5 marks)**

14. **a.** Derive the expression for the force on the stationery inclined flat plate and also horizontal and vertical components of this force. **(5 marks)**

b. A nozzle of 50 mm diameter delivers a stream of water at 20 m/s perpendicular to a plate that moves away from the jet at 5 m/s. Find the force on plate and the efficiency of jet. **(5 marks)**

15. Show that in case of laminar flow through pipes the co-efficient of friction f is function of Reynolds number R_e. i.e. $f=16/R_e$. **(10 marks)**

16. **a.** Derive the expression for power required to overcome the viscous resistance in case of journal bearing. **(5 marks)**

b. An oil of viscosity 0.02 Pa.s is flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/s. Calculate pressure gradient along flow, the average velocity and the discharge. **(5 marks)**

17. **a.** Derive the relation between the rise of liquid level at the ends and fall of liquid level at axis of rotation in case of forced vortex.**(5 marks)**

b. A closed cylinder of diameter 200 mm and height 150 mm is completely filled with water. Calculate the total pressure force exerted by water on the top and bottom of the cylinder, if it is rotated about its vertical axis at 200 rpm. What will be the pressure on bottom if the cylinder in not rotating? **(5 marks)**

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