Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – June 2023

Programme Name: B Tech (ME)

Semester: IV

Subject Code: UG11T3405

Subject Name: Fluid Mechanics-I

Date: 29.05.2023	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

Section A
(All Questions are compulsory)

Ten MCQs/Fill in the Blanks of 1 Mark Each, Choose the correct answer.

(Marks 10x1=10)

1. When there are no external forces, the shape of a liquid drop is determined by
a. The viscosity of the liquid
b. The density of the liquid
c. Surface Tension of the liquid
d. The temperature of air only

2. The intensity of pressure at any point, in a liquid, is
a. Directly proportional to the area of the vessel containing liquid
b. Directly proportional to the depth of liquid from the surface
c. Directly proportional to the length of the vessel containing liquid
d. Inversely proportional to the depth of liquid from the surface

3. If a particle has negative velocity and negative acceleration, its speed
a. increases
b. decreases
c. remains same
d. zero

4. During the opening of a valve in a pipe line, the flow is

a. Steady
b. Unsteady
c. Uniform
d. Laminar

5. The condition for maximum power in impact of jets is...

a. U= V/2
b. U= V×2
c. U= V/4
d. V= U/2

6. When a ship enters a sea from a river, one can expect it to:
a. rise a little
b. sink a little
c. remain at the same level of draft
d. rise or fall depending on whether it is of wood or steel

7. The hydraulic mean depth or the hydraulic radius is the ratio of
a. area of flow and wetted perimeter
b. wetted perimeter and diameter of pipe
c. velocity of flow and area of flow
d. none of these

8. Which among the following is an assumption of Hagen-Poiseuille equation?
a. Fluid is uniform
b. Fluid is laminar
c. Fluid is turbulent
d. Fluid is compressible

9. In a free vortex, the flow is:
a. rotational
b. irrotational
c. rotational or irrotational
d. neither rotational or irrotational

10. The motion of air mass in a tornado is a:
a. forced vortex motion
b. free vortex motion
c. free vortex at centre and forced vortex outside
d. forced vortex at centre and free vortex outside

Section B
(All Questions are compulsory)

Five Short Questions of 02 Marks each

(Marks 5x2=10)

11. Explain conditions for stable, unstable & neutral equilibrium for submerged body.

12. What are the assumptions of Bernoulli's equation of motion? Write Various applications of Bernoulli's equation

13. Draw profile of velocity and shear stress distribution of viscous flow at a section in pipe

14. Which dimension of a pipe is very important to define a standard pipe and why?

15. Define forced vortex flow and give two examples

Section C

Attempt any 5 Questions out of 7 and Each Question carrying 10 Marks. (Marks 5x10=50)

16. A single column vertical manometer (i.e., micro manometer) is connected to a pipe containing oil of sp.gr. =0.9. The area of the reservoir is 80 times the area of the manometer tube. The reservoir contains mercury of sp.gr. =13.6. The level of mercury in the reservoir is at a height of 30cm below the centre of the pipe and difference of mercury levels in the reservoir and right limb is 50 cm. Find the pressure in the pipe.

(Marks 10)

17. Each gate of a Lock gate is 9m high. When the gates are closed, they make an angle of 120 degree. The width of the lock is 10m. Each gate is supported by two hinges located at 1m and 6 m above the bottom of the lock. The depths of water on the two sides are 8m and 4m respectively. Find (a) Resultant water force on each gate (b) Reaction between the gates (c) Force on each hinge, considering the reaction of the gate acting in the same horizontal plane as resultant water pressure. (Marks 3+3+4)

18. Find (a) the velocity at throat and (b) discharge of water flowing downward through a pipe 30 cm diameter placed in an inclined position where a Venturimeter is inserted, having a throat diameter of 15 cm. The difference of pressure between the main and throat is measured by a liquid of sp. gr. 0.6 in an inverted U-tube which gives a reading of 30 cm. The loss of head between the main and throat is 0.2 times the kinetic head of the pipe (Marks 7+3)

19. a) Prove that the force exerted by the jet striking at centre of the curved vane is greater than that exerted on the flat vane.

b) What are the advantage and disadvantage of jet propulsion of ship over screw propeller? (Marks 7+3)

20. a)Derive equations of torque and power due to viscous resistance in Collar bearing.

b) The external and internal diameters of a Collar bearing are 20 cm and 15 cm respectively. Between the collar surface and the bearing, an oil film thickness 0.025cm and of viscosity 0.9 poise is maintained. Find the H.P.loss in overcoming the viscous resistance of the oil when the shaft is running at 250 rpm. (Marks 5+5)

21a) For a water supply, a main pipe line of diameter 0.4 m is required. As pipes more than 0.35 m diameter are not readily available at site, two parallel pipes of same diameter were used for water supply. If the total discharge in the parallel pipes is same as in the single main pipe, find the diameter of the parallel pipe. Assume the coefficient of friction same for all pipes.

b)Derive condition for maximum power transmission through pipe. (Marks6+4)

22 a) Derive equation of motion of forced vortex flow and from its equation, prove that top surface of vortex motion is paraboloid.

b) A closed cylinder of diameter 30 cm and height 20 cm is completely filled with water. Calculate the total pressure force exerted by water on the bottom of the cylinder, if it is rotated about its vertical axis at 300 rpm. (Marks 5+5)