B.Tech/M.Tech(Integrated) DEGREE EXAMINATION, DECEMBER 2023

Third Semester

21ASC203T - APPLIED FLUID MECHANICS

(For the candidates admitted during the academic year 2022-2023 onwards)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
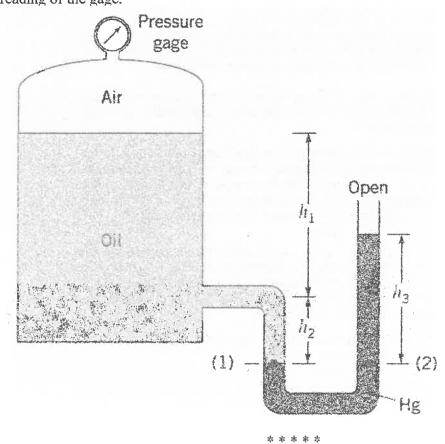
ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours   **Max. Marks: 75**

PART - A (20 × 1 = 20 Marks)
Answer all Questions

		Marks	BL	CO
1.	The value of the viscosity of an ideal fluid is	1	1	1
	(A) More than that of a real fluid (B) Unity			
	(C) Zero (D) Infinity			
2.	The value of the surface tension of an ideal fluid is	1	2	1
	(A) Zero (B) Unity			
	(C) Infinity (D) More than that of a real fluid			
3.	If a uniform solid body weighs 50 N in air and 30 N in Water, it's Specific Gravity is	1	3	1
	(A) 1.5 (B) 2.5			
	(C) 1.67 (D) 3.00			
4.	On a sea level standard day, a pressure gage moored below the surface of ocean, Specific gravity 1.025, reads an absolute pressure of 1.4 MPa. How deep is this instrument	1	3	1
	(A) 129m (B) 4m			
	(C) 133m (D) 140m			
5.	Steady flow occurs when	1	1	2
	(A) The pressure does not change along the flow (B) The velocity does not change			
	(C) Conditions do not change with time at any point (D) Conditions change gradually with time			
6.	A one dimensional flow is one which	1	2	2
	(A) Involves zero transverse component of flow (B) Is uniform flow			
	(C) Is steady uniform flow (D) Takes place in straight lines			
7.	A flow in which each liquid particle has a definite path and their paths do not cross each other is called	1	2	2
	(A) Uniform flow (B) Steady flow			
	(C) Turbulent flow (D) Laminar flow			
8.	If the particles of a fluid attain such velocities that vary from point to point in magnitude and direction as well as from instant to instant, the flow is said to be	1	2	2
	(A) Steady flow (B) Turbulent flow			
	(C) Laminar flow (D) Uniform flow			
9.	The streamlines of the particles in a flow are recorded. If the streamline distribution remain the same even after sometime, what type of flow can it be?	1	2	3
	(A) Non-Uniform (B) Steady			
	(C) Uniform (D) Unsteady			

10. The continuity equation — 1 1 3
   (A) Relates the mass rate of flow along a stream line
   (B) Expresses relationship between hydraulic parameters of flow
   (C) Expresses the relation between work and energy
   (D) Is a relation for the momentum per unit volume for two points on a stream line

11. For incompressible fluid flow, if area reduces then what is the effect on the velocity? — 1 2 3
   (A) Decreases
   (B) Increases
   (C) Constant
   (D) first increases then decreases

12. The flow in which fluid moves radially inwards towards a point is called — 1 1 3
   (A) Vortex flow
   (B) Source flow
   (C) Sink flow
   (D) Source and sink pair

13. The Reynolds number is the ratio of — 1 1 4
   (A) Inertial forces to surface tension force
   (B) Elastic forces to pressure forces
   (C) Inertial forces to gravity forces
   (D) Inertial forces to viscous forces

14. Velocity distribution for laminar flow through a circular pipe is — 1 2 4
   (A) Varies linearly from zero at wall and max. at center
   (B) Varies parabolically with maximum at center
   (C) Constant over the cross section
   (D) Varies linearly to max at wall and zero at center

15. The shear stress velocity gradient relation of the Newtonian fluids is — 1 2 4
   (A) Hyperbolic
   (B) Parabolic
   (C) Linear
   (D) Nonlinear

16. Flow in which compressibility of fluid depends on — 1 2 4
   (A) Reynolds number
   (B) Euler's number
   (C) Mach number
   (D) Weber's number

17. The turbulent boundary layer is _____ — 1 1 5
   (A) Uniform
   (B) Non-uniform with swirls
   (C) Less stable
   (D) Smooth

18. The swirl caused due to eddies are called as _____ — 1 1 5
   (A) Vortices
   (B) Vertices
   (C) Volume
   (D) Velocity

19. The wake is a region of always occurs — 1 1 5
   (A) Before a separation point
   (B) After a separation point
   (C) Before and after separation point
   (D) At region of high pressure intensity

20. In which of the following types of flow the losses are maximum? — 1 2 5
   (A) Turbulent flow
   (B) Laminar flow
   (C) Critical flow
   (D) Transition flow

PART - B (5 × 8 = 40 Marks)
Answer all Questions

Marks BL CO

04DA3-21ASC203T

21. (a) The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm.   8   3   1

(OR)

(b) (i) The surface tension of water in contact with air at 20 deg. C is 0.0725 N/m. The pressure inside a droplet of water is to be 0.02 N/cm^2 greater than the outside pressure. Calculate the diameter of the droplet of water.

(ii) A hydraulic press has a ram of 30cm diameter and a plunger of 4.5cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500 N.

22. (a) A fluid of specific gravity 0.8 is flowing through a horizontal venturimeter having inlet diameter 20cm and throat diameter 10 cm. A U-tube manometer containing mercury as the manometric fluid is connected between the inlet and throat shows a reading of 25 cm. Calculate the discharge of oil through the venturimeter. Take coefficient of discharge of venturimeter as 0.98.   8   3   2

(OR)

(b) When an airplane is flying 322 kmph at 5000-ft altitude (density=1.06 kg/m^3, pressure=84311 Pa) in a standard atmosphere, the air velocity at a certain point on the wing is 439 kmph relative to the airplane. What suction pressure is developed on the wing at that point? What is the pressure at the leading edge (a stagnation point) of the wing?

23. (a) Obtain the expressions and sketch the stream function and velocity potential for (i) Source flow and (ii) free vortex.   8   3   3

(OR)

(b) For the potential flow over a stationary cylinder, find and sketch the pressure coefficient distribution over the cylinder surface.

24. (a) For a fully developed laminar flow through a pipe, obtain the expressions and sketch the
(i) velocity profile
(ii) Shear Stress   8   4   4

(OR)

(b) Drag force F on a high speed aircraft depends on the velocity of the flight V, the characteristic geometric dimension of the aircraft l, the density ρ and viscosity μ. Using Buckingham π theorem, find out the independent dimensionless quantities which describe the phenomenon of drag on the aircraft.

25. (a) Derive the Von-Karman momentum integral equation for boundary layer over a flat plate.   8   4   5

(OR)

(b) Experiments are performed in a wind tunnel with a wind speed of 14 m/s on a flat plate of size 2m long and 1m wide. The density of air is 1.2 kg/m^3. The coefficients of lift and drag are 0.75 and 0.15 respectively. Determine: (i) Lift force (ii) Drag force (iii) Resultant force and its direction and (iv) power exerted by air on the plate.

PART - C (1 × 15 = 15 Marks)
Answer **any 1** Questions

Marks BL CO

26. Consider two potential vortices of equal strengths are kept at equal distance from the origin along the x axis on either side of the Y axis. Draw the streamline pattern (in a cartesian graph) of the flow considering at least two streamlines between the centers of the vortices and the origin of the 2D coordinate system. (Assume any values for the vortex strength and the distance from Y axis)   15   4   3

27. A closed tank contains compressed air and oil ($SG_{oil}=0.9$) as is shown in Fig. A   15   4   2
    U-tube manometer using mercury is connected to the tank as shown. The column
    heights are $h_1 = 90$ cm and $h_2 = 15$ cm, and $h_3 = 22.5$ cm. Determine the pressure
    reading of the gage.

* * * * *