Question Paper

Exam Date & Time: 22-Nov-2018 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
THIRD SEMESTER B. Sc. (Applied Sciences) in Engg.
END SEMESTER THEORY EXAMINATION
NOVEMBER-2018
FLUID MECHANICS [IME 234]

Marks: 100 **Duration: 180 mins.**

C

Answer 5 out of 8 questions.

Missing data may be suitably assumed.

1)	A)	Calculate the capillary effect in mm in a glass tube of 4 mm diameter, when immersed in Hg. The temperature of liquid is 20^{o}C and surface tension of Hg at 20^{o}C in contact with air is 0.51 N/m. Angle of contact is 130^{o}. (Specific gravity of Hg is 13.6).	(6)
	B)	Define the following properties of fluid with proper notations: (i) Density, (ii) Specific Volume, (iii) Specific gravity, (iv) Kinematic viscosity, (v) why are liquids and gases together called fluids?	(10)
	C)	Define Newton's law of viscosity and derive an expression for shear stress.	(4)
2)		State and prove Hydrostatic law.	(6)
	A)		
	B)	The right limb of a simple U-tube manometer containing Hg is open to atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The center of the pipe is 12 cm below the level of Hg in the right limb. Find the pressure of fluid in the pipe if the difference of Hg level in the two limbs is 20 cm.	(10)
	C)	Explain the following: (i) Absolute pressure, (ii) Gauge Pressure, (iii) Vacuum Pressure.	(4)
3)	A)	Find an expression for the force exerted and center of pressure for a completely submerged inclined plane surface. Can the same method be applied for finding the	(10)

resultant force on a curved surface immersed in the liquid? If not, why?

B) A cylinder 3 m in diameter and 4 m long retains water on one side. The cylinder is supported as shown in the Figure Q (3B). Determine the horizontal reaction at A and the vertical reaction at B. The cylinder weighs 196.2 kN. Ignore friction. (10)

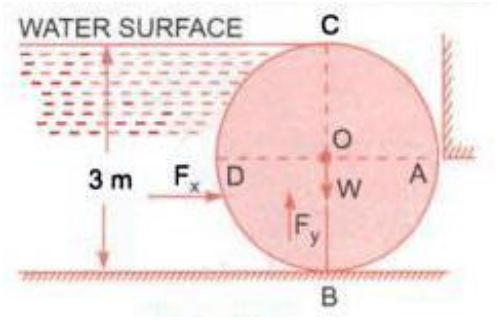

FIG Q (3B)

4) Derive an expression for meta centric height using analytical method (10)

A)

B) A cone of specific gravity S, is floating in water with its apex downwards. It has a diameter D and vertical height H. Show that for stable equilibrium of the cone, (10)

$$H < \frac{1}{2}\left[\frac{D^2 S^{1/3}}{2 - S^{1/3}}\right]^2$$

5) Derive continuity equation in 3 dimensions. Also write the expression for the following cases: (i) Steady flow, (ii) compressible steady flow, (iii) uniform flow, (iv) two dimensional flow. (10)

A)

B) The velocity vector in a fluid flow is given as $4x^3i-10x^2yj+2tk$ m/s. find the velocity and acceleration of a fluid particle at (2,1,3) at time t=1s. (10)

6) Derive Bernoulli's Equation using Euler's equation. (10)

A)

B) 250 lps of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bent by 135Â°, find the magnitude and direction of the resultant force on the bend. The pressure of water flowing is 39.24 N/cm^2. (4)

C) In a vertical pipe conveying oil of specific gravity 0.8 two (6)

pressure gauges have been fixed at A and B where the diameters are 16 cm and 8 cm respectively. A is 2m above B. The pressure gauge readings have shown that the pressure at B is greater than that at A by 0.1 kgf/cm^2. Neglecting all losses, calculate the flow rate. If the gauges at A and B are replaced by a U tube differential manometer containing mercury and same oil flowing in the pipe, calculate the reading of the manometer.

7) A) Discuss the requirements for accurate fluid mechanical testing of models, such as models of aircraft and cars. What are the practical limitations? Use dimensionless parameters to help explain and highlight its significance. (4)

B) Explain the concept of dimensional homogeneity with the help of an example (4)

C) The resisting force of a supersonic plane during flight can be considered to be dependent on the length of the aircraft L, velocity V, viscosity μ, mass density ρ, and bulk modulus K. Express the fundamental relationship between resisting force and these variables. (12)

8) A) Derive an expression for velocity distribution in circular pipe. (10)

B) A shaft having a diameter of 50 mm rotates centrally in a journal bearing having a diameter of 50.15 mm and length 100 mm. The annular space between the shaft and the bearing is filled with oil having viscosity of 0.9 poise. Determine the power absorbed in the bearing when the speed of rotation is 60 rpm. (10)

-----End-----