

Printed Pages : 4



ECH-303

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 151306

Roll No.

--	--	--	--	--	--	--	--	--	--

B.Tech.

(SEM.III) (ODD SEM.) THEORY
EXAMINATION, 2014-15
FLUID FLOW OPERATIONS

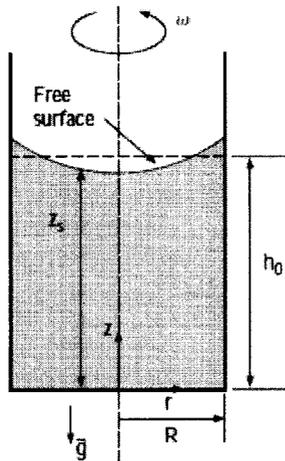
Time : 3 Hours]

[Total Marks : 100

- Note :
- (1) Attempt All questions.
 - (2) Assume missing data if any.

1. Answer any FOUR parts: **5x4=20**
 - (a) Explain the following terms: Vapor pressure and Bulk modulus?
 - (b) What are the desirable properties of manometric fluid?
 - (c) Sketch stress versus strain diagram for Non-Newtonian fluid?
 - (d) How does a U - tube manometer function? Derive an expression for $(P_1 - P_2)$ in terms of measurable quantities.
 - (e) Distinguish between compressible and incompressible fluids?

- (f) A 20 cm diameter, 60 cm high vertical cylinder container is shown below which is partially filled with 50 cm high liquid whose density is 850 kg/m^3 . Now the cylinder is rotated at constant speed. Determine the rotational speed at which the liquid will start spilling from the edge of container?



2. Answer any FOUR parts: **5x4=20**
- (a) What are the advantages of dimensional analysis? State Buckingham π theorem?
- (b) Pressure drop of a homogeneous fluid in a straight smooth pipe (ΔP) is a function of the pipe geometry (diameter d , and length l), the physical properties of the fluid (density ρ and viscosity μ) as well as its velocity v .
- $\Delta P = f(d, l, \rho, \mu, v)$ Using dimensional analysis, find out the relationship between dimensionless groups?

- (c) Define Similitude. Explain the different types of similarities in fluid flow processes.
- (d) Given the velocity field

$$V(x, y, z, t) = (5xy^2 + t)\mathbf{i} + (2z + 8)\mathbf{j} + 18\mathbf{k} \text{ m/s, where } x, y, z \text{ in meters and } t \text{ in seconds. Calculate } V(9, -2, 1, 4). \text{ What is magnitude of this velocity?}$$
- (e) An incompressible steady flow pattern is given by $u = x^4 + 3z^4$ and $w = y^4 - 3yz$. What is the most general form of the third component, $v(x, y, z)$, that satisfies continuity equation?
- (f) Write the purposes of agitation of liquids. Draw neat sketches of various impellers and explain their specific features.

3. Answer any TWO parts: 10x2=20

- (a) State and prove the Bernoulli's theorem for incompressible fluid and indicate the corrections necessary for its application.
- (b) Discuss how non dimensionalization of the Navier stokes equation is helpful in obtaining approximate solutions. Give an example? What is the most significant danger associated with an approximate solution of Navier stokes equation?
- (c) Water is pumped from a reservoir to a height of 1000 m from the reservoir level, through a pipe of 15 cm I.D. at an average velocity of 4 m/s. If the pipeline along with the fittings is equivalent to 2000 m long and the overall efficiency is 70%, what is the energy required for pumping? Friction factor

$$f = 0.046 \text{ Re}^{-0.2} \text{ and } \rho = 1000 \text{ kg/m}^3 \text{ and } \mu = 0.001 \text{ kg/m.s}$$

4. Answer any TWO parts: **10x2=20**
- (a) With the help of a neat sketch, explain the working principle and operation of a Rotameter? Explain the velocity measurement by Pitot tube with the help of a neat sketch.
 - (b) Explain the principle, construction and working of an orifice meter with the help of a neat sketch.
 - (c) A horizontal venturi meter having a throat diameter of 4 cm is set in a 10 cm I.D. pipeline. Water flows through the system and the pressure differential across the venturi meter is measured by means of a simple U-tube manometer filled with mercury. Estimate the flow rate when the manometer reading is 30 cm. Assume $C_v = 0.98$. If 10% of the pressure differential is permanently lost, calculate the power consumption of the meter.
 $\rho_m = 13.6 \text{ g/cc}$ and $\rho = \text{g/cc} = 1000 \text{ kg/m}^3$

5. Answer any TWO parts: **10x2=20**
- (a) Define net positive suction head and required net positive suction head and explain how these two quantities' are used to ensure that cavitation does not occur in a pump? State and give reasons whether a centrifugal pump with radial blades has higher efficiency than the same pump with backward inclined blades?
 - (b) Explain the various performance curves of a centrifugal pump.. Describe the working principle of any one type rotary pump with a neat sketch.
 - (c) write briefly the characteristic features and industrial applications of blowers and compressors? Briefly explain the method of selecting a pump for a given application