

Roll No. 761044.....

Total No. of Pages : 3

BT-4/M11

8454

Fluid Mechanics

(w.e.f. 2006 onwards)

Paper—ME-208E, Option—I

Time : Three Hours]

[Maximum Marks : 100

Note :—Attempt **FIVE** questions in all, selecting at least **ONE** question from each unit..

UNIT—I

1. (a) Differentiate between following :
- (i) Kinematic and Dynamic Viscosity
 - (ii) Cohesion and Adhesion
 - (iii) Newtonian and Non-Newtonian fluid
 - (iv) Bulk modulus and compressibility of a fluid. 8
- (b) Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. 12
2. (a) Define and distinguish :—
- (i) Rotational and irrotational flow
 - (ii) Steady and Unsteady flow
 - (iii) Circulation and Vorticity. 9
- (b) If the expression for stream function is described by $\psi = x^3 - 3xy^2$, determine whether flow is irrotational or rotational. If the flow is irrotational, then indicate the correct value of the velocity potential :
- (i) $\phi = y^3 - 3x^2y$
 - (ii) $\phi = - 3x^2y$. 11

UNIT—II

3. (a) State and prove Bernoulli's theorem. List the assumptions made and limitations also. 8
- (b) Describe an orificemeter and find an expression for measuring discharge of fluid through a pipe with this device. 6
- (c) What is Pitot tube ? How is it used to measure velocity of flow at any point in a pipe or channel ? 6
4. (a) 360 litres per second of water is flowing in a pipe. The pipe is bent by 120° . The pipe bend measures $360 \text{ mm} \times 240 \text{ mm}$ and volume of the bend is 0.14 m^3 . The pressure at the entrance is 72 kN/m^2 and the exit is 2.4 m above the entrance section. Find the force exerted on the bend. 8
- (b) Explain the following :—
- (i) Free and forced vortex flow
 - (ii) Kinetic energy correction factor
 - (iii) Momentum correction factor. 12

UNIT—III

5. (a) Derive Hagen-Poiseuille equation and state the assumptions made. 12
- (b) A liquid with a specific gravity 2.8 and a viscosity 0.8 poise flows through a smooth pipe of unknown diameter, resulting in a pressure drop of 800 N/m^2 in 2 km length of the pipe. What is the pipe diameter if the mass flow rate is 2500 kg/h ? 8
6. (a) Explain in brief :—
- (i) Hydraulic Gradient Line (HGL)
 - (ii) Energy Gradient Line (EGL). 6

- (b) Derive an expression for the power transmission through the pipes. Find also the condition for maximum transmission of power. 6
- (c) Two pipes of diameter 400 mm and 200 mm each, 300 m long. When the pipes are connected in series the discharge through the pipe line is $0.10 \text{ m}^3/\text{sec}$, find the loss of head incurred. What would be the loss of head in the system to pass the same total discharge when the pipes are connected in parallel ? Take friction factor = 0.0075 for each pipe. 8

UNIT—IV

7. (a) Discuss the following in regards to Boundary layer :
- (i) Boundary layer thickness
 - (ii) Displacement thickness
 - (iii) Momentum thickness. 6
- (b) What is Blasius one seventh power law of velocity distribution. 8
- (c) What is laminar sublayer ? How this concept is useful ? 6
8. (a) Distinguish between hydrodynamically smooth and rough boundaries. 6
- (b) Explain what is meant by separation of boundary layer. Describe with sketches the methods to control separation. 8
- (c) Differentiate between a streamlined body and a bluff body. 6