

J 1082

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2006.

Third Semester

Civil Engineering

CE 233 — FLUID MECHANICS

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

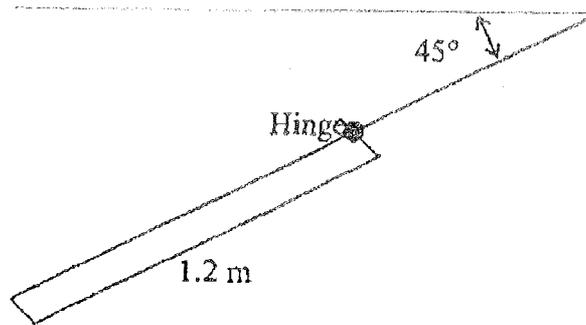
PART A — (10 × 2 = 20 marks)

1. Define Viscosity.
2. Calculate the capillary effect in 'mm' in glass tube of 2.5 mm radius, when immersed in mercury. Take surface tension of mercury as 0.51 N/m.
3. Define path line and Streak line.
4. Calculate the specific gravity of a liquid if the pressure 6 m below its free surface is 52 KPa.
5. State the assumptions used in deriving Bernoulli's equation.
6. What is mean by boundary layer growth?
7. Write the conditions for flow to be separated and on the verge of separation.
8. Name the flow measuring instruments which use the Bernoulli's equation.
9. Mention the characteristics of parallel pipes.
10. What is mean by distorted model?

PART B — (5 × 16 = 80 marks)

11. (i) A plate of area $1.5 \times 10^6 \text{ mm}^2$ is pulled. If the equation of a velocity profile over a plate is $u = 2y^{(2/3)} - y^3$, compute shear stress at $y = 0$, $y = 75 \text{ mm}$. Take $\mu = 8.35 \text{ poise}$. Also calculate the force and power required to maintain the speed. (10)
- (ii) Define Surface tension. Derive the expression for surface tension on a Hollow bubble and Liquid jet. (6)

12. (a) An inclined rectangular sluice gate has been shown in figure below. The size of plate is 1.2 m × 5 m. The plate makes an angle of 45° with horizontal free water surface. Determine the total pressure and force required to open the gate. (16)



Or

- (b) (i) In two dimensional potential flow, the velocity potential is given by $\Phi = 4x(3y - 4)$, determine the value of stream function at the point (3,4). Also find the value of velocity potential at the same point. (10)
- (ii) A member of size 2.5 m × 1.5 m × 4 m floats in water. What is the weight of member if depth of immersion is 0.9 m. Also determine Meta-centric height of the member. (6)
13. (a) The difference in water level in two reservoirs, which are connected by three pipes in series of lengths 275 m, 180 m and 235 m and of diameters of 300 mm, 400 mm and 250 mm respectively, is 13 m. Determine the rate of flow if $f_1 = 0.006$, $f_2 = 0.0058$ and $f_3 = 0.0055$ respectively, (i) considering Minor losses and (ii) Neglecting minor losses, (iii) Draw TEL and HGL. (16)

Or

- (b) Vertical pipe is used to convey the oil of specific gravity 0.9. In order to measure the pressure two pressure gauges are attached at A and B. The pressure gauge readings have shown that the pressure at B is greater than at A by 0.981 N/cm². The diameter at A is 160 mm and that of B is half of Diameter at A. The point B is 2.5 m below A. Neglecting all losses find rate of flow. If pressure gauges are replaced by U-tube manometer, calculate the difference of level of mercury in two limbs of the U-tube. (16)
14. (a) Which law is used in deriving the continuity equation? Derive the Continuity Equation for fluid flows in three dimensions and reduce that to two dimensional flow and one dimensional flow. (16)

Or

- (b) (i) Derive the equation for displacement and momentum thickness in the boundary layer. (10)
- (ii) Derive the expression for head loss due to sudden contraction. (6)

15. (a) The resisting force of a supersonic aircraft during its flight can be assured to depend on following variables such as length, velocity, viscosity, density and bulk modulus. With the help of Buckingham theorem derive an expression showing the relationship between resisting force and these variables. (16)

Or

- (b) The scale ratio of a model is $1/12$. What will be the flow in model if that of the same in prototype is $30\text{m}^3/\text{s}$. If the measured velocity in the model is 2.4 m/s what will be the corresponding velocity in its prototype. If the hydraulic jump produced in the model is 5 cm then find the hydraulic jump developed in the prototype. If energy dissipated per sec in the model is 35 N/m calculate the energy dissipated per sec in the prototype. (16)