Code No. 3022

FACULTY OF ENGINEERING

B.E. 3/4 (Civil) First Semester (Suppl.) Examination, June/July 2011

FLUID MECHANICS—II

Time : Three Hours] [Maximum Marks : 75

Note :— Answer **ALL** questions from Part—A and any **FIVE** questions from Part—B.

PART—A (Marks : 10×2·5=25)

1. A rectangular channel 2·5 m wide carries water at a depth of 1·2 m. The bedslope of the channel is 0·0036. Calculate the average shear stress on the boundary.
2. In a supercritical flow in a rectangular channel, a smooth expansion changes the width from B_1 to B_2. This causes the water surface elevation after the expansion to (a) increase (b) decrease (c) remain unchanged (d) increase or decrease depending upon the channel roughness.
3. What is Froude Model law and define the Scale Ratio of Force ?
4. The Froude number at the end of a hydraulic jump in a rectangular channel is 0·25. Determine the sequent depth ratio.
5. Define water hammer phenomenon.
6. What type of drag is predominant on a parachute and an arrow moving in air ?
7. A 1 : 50 spillway model has a discharge of 1·25 m^3/s. What is the corresponding prototype discharge ?
8. Define dynamic similarity.
9. When do you use unit quantities and specific quantities ?
10. Define minimum starting speed.

PART—B (Marks : 50)

11. (a) A trapezoidal channel is to be designed to convey 60 m^3/s of water at a velocity of 2 m/s. The bedwidth to depth ratio is to be 6·0 and the side slopes are to be 1 H : 1 V. Assume n = 0·02. Calculate the bedwidth, depth of flow and slope of the channel. 5

    (b) For the most economical trapezoidal channel show that the side slope of the channel is 1 H : $\sqrt{3}$ V. 5

12. (a) Explain the variation of water surface profile over a hump using specific energy diagram. 5

(b) Derive the dynamic equation of a gradually varied flow. 5

13. (a) A river 90 m wide and 3 m deep has stable bed and vertical banks with a surface slope of 1 in 2500. Estimate the length of backwater curve produced by an afflux of 2 m. Assume n = 0·035. 5

(b) List out the various types of surface profiles. A sluice gate discharges water into a horizontal rectangular channel with a velocity of 10 m/s and a depth of flow of 1 m. Determine the depth of flow after the jump and consequent loss in total head. 5

14. (a) Estimate the maximum time for a sudden closure of a valve in a pipe of 80 cm diameter, 1000 m long carrying kerosene at 1·25 m^3/s. Assume relative density of kerosene as 0·8, bulk modulus = $1·43 \times 10^9$ Pa. Modulus of elasticity for the pipe material is $2·1 \times 10^{11}$ Pa. Assume the wall thickness of the pipe is 80 mm. 5

(b) Explain the boundary layer growth over a flat plate. 5

15. (a) Experiments were conducted in a wind tunnel with a wind speed of 50 kN/hr, on a flat plate of size 2 m long and 1 m wide. The specific weight of air is 11·28 N/m^3. The plate is kept at such an angle that the coefficients of lift and drug are 0·75 and 0·15 respectively. Determine the lift force, drag force, resultant force and power exerted by the air stream on the plate. 5

(b) A ship model 1 m long with negligible friction is tested in a towing tank at a speed of 60 cm/s. To what ship velocity does this correspond if the ship is 60 m long. A force of 4·9 N is required to tow the model. What propulsive force does this represent in the prototype ? 5

16. (a) Explain geometric, kinematic and dynamic similarity. 5

(b) For laminar flow in a pipe, the drop in pressure ΔP is a function of the pipe length 'L', its diameter 'D', mean velocity of flow 'V' and dynamic viscosity 'μ'. Using Raleigh's method, develop an expression for ΔP. 5

17. (a) A Francis turbine produces 6750 KW at 300 rpm under a net head of 45 m with an overall efficiency of 85%. What would be the revolutions per minute, discharge and brake power of the same turbine under a net head of 60 m under homologous conditions ? 5

(b) Explain the characteristic curves of centrifugal pumps. 5