T.E. (Civil) (Semester – I) Examination, 2010
FLUID MECHANICS – II (New)
(2008 Course)

Time: 3 Hours Max. Marks: 100

Instructions : *i) Answer **Q.1** or **Q.2, Q.3** or **Q.4, Q.5** or **Q.6** in Section **I**.*

*ii) Answer **Q.7** or **Q.8, Q.9** or **Q.10, Q.11** or **Q.12** in Section **II**.*

*iii) Answer to the **two** Sections should be written in **separate** answer booklet.*

*iv) **Neat** diagrams must be drawn **wherever** necessary.*

*v) Black figure to the **right** indicate **full** marks.*

*vi) Your answer will be valued as a **whole**.*

*vii) **Use** of electronic pocket calculator is **allowed**.*

*viii) **Assume** suitable data, **if necessary**.*

SECTION – I

1. a) A rectangular tank 6 m long by 1.5 m wide is divided into two parts by a partition so that one part is 4 times the other part. The water level in the large portion is 3 m above that in the smaller. Find the time required for the difference of water levels in the two portions to be reduced to 1.2 m, if the water flows through an orifice at the bottom of the partition having an area of 58 cm^2 and $c_d = 0.6$. 8

b) Explain Karman Vortex Trail. 4

c) State various types of drags and discuss effect of free surface on drag. 6

OR

2. a) Experiments were conducted in a wind tunnel with a speed of 54 km/h on a flat plate of size 2.4 m long and 1.25 m wide. The density of air is 1.20 kg/m^3. The plate is kept at an angle and the coefficient of lift and drag are 1.2 and 0.25 respectively. Determine (i) the lift force (ii) drag force (iii) resultant force (iv) direction of resultant and (v) power expended in overcoming resistance of the plate. 10

b) Explain one complete cycle of the water hammer phenomenon giving details of each stage. 8

3. a) A jet of water with a velocity of 30 m/s impinges on a moving vane of velocity 12 m/s at 30 to the direction of motion. The vane anagle at the outlet is 18. Find 8

i) The blade angle at inlet so that the water enters without shock.

ii) The work done on the vane per unit weight of water per second entering the vane

iii) The efficiency.

b) Explain the following terms related to a centrifugal pump 8

i) Minimum starting speed ii) Hydraulic losses

iii) Cavitation iv) N.P.S.H.

OR

4. a) Obtain the expression for the force acting, work done and efficiency in case of a single moving curve vane when the jet of water strikes and leaves the vane tangentially. 8

b) In a centrifugal pump it is usual to make the external diameter D_1 of the impeller to be twice the internal diameter (D). For this condition, show that the minimum diameter of an impeller which will enable it to pump water to a head H meters at a speed of N rpm at a manometric efficiency of 0.70 is 8

$$D_1 = \frac{81.7\sqrt{H}}{N} \text{ meter}$$

5. a) A Pelton wheel 2.5 m diameter operates under the following conditions 8

Net available head (H)	= 300 m
Speed (N)	= 300 rpm
Coefficient of velocity of the jet (C_v)	= 0.98
Friction coefficient for vanes (K)	= 0.95
Blade angle (φ)	= 15°
Diameter of the jet (d)	= 20 cm
Mechanical efficiency (η_m)	= 0.95

Determine (i) the power developed (ii) hydraulic efficiency (iii) specific speed.

b) Draw a neat sketch of a typical Hydro-electric power plant indicating all the major components and state functions of each of the components. 8

OR

6. a) Derive expressions for unit speed and unit discharge of turbines. 8

   b) A Francis turbine of diameter 3.0 m develops 6750 kW at 300 rpm under a net head of 45 m. A geometrically similar model of scale ratio 1 : 8 is to be tested at a head of 9 m. Estimate the speed, discharge and power developed by the model. What is the specific speed for the model ? Assume overall efficiency of 0.82 for both the prototype and model. 8

SECTION – II

7. a) Derive the continuity equation for open channel flow. 6

   b) Differentiate between pipe flow and open channel flow. 4

   c) Determine the dimensions of the most economical open channel of trapezoidal section to give an area 25 m^2. The side slopes of the channel are 1 : 2. Find the discharge if the bed slope is 1 : 2000 and Chezy's C = 45. 8

OR

8. a) Explain factors affecting Manning's roughness coefficient. 6

   b) Derive the Chezy's formula for uniform flow in an open channel. List the factors that affect the Chezy's coefficient. 6

   c) Write a short note on 'Velocity distribution in open channel flow'. 6

9. a) A rectangular channel is 3 m wide and carries a flow of 1.85 m^3/s at a depth of 0.5 m. A contraction of the channel width is required at a certain section. Find the greatest allowable contraction in the width for the upstream flow to be possible as specified. 8

   b) Starting from first principle, derive an expression for the loss of energy due to jump in the form 8

$$\Delta E = \frac{(y_2 - y_1)^3}{4 y_1 y_2}$$

OR

10. a) For a hydraulic jump in a rectangular channel, the loss of energy in the jump is 3.75 m and the pre-jump Froude number is 7.5. Determine- 8

   i) The rate of flow

   ii) The conjugate depths

   iii) Relative loss

   b) State the characteristics of critical flow. 3

   c) Explain channel transition with hump for sub-critical flow. Also draw sketches to show variation of depths over hump for the above transition. 5

11. a) A wide rectangular channel carries a discharge of 3 $m^3/s/m$. The bed slope of the channel is 1:2500 and Manning's n = 0.08. At a certain section along this channel deph of flow is 2.25 m. How far upstream or downstream of this section the depth of flow will be within 10% of the normal depth ? Use direct step method. Use two steps only. 10

   b) State practical examples of S_1, S_2, S_3 profiles. Draw figures for each. 6

OR

12. a) State the assumptions made in the analysis of GVF. 3

   b) Classify the channel bed slopes and show various zones. 5

   c) What do you understand by GVF ? Show that for GVF in a channel, the water surface slope, with usual notations may be written as 8

$$\frac{dy}{dx} = \frac{S_0 - S_f}{1 - F_r^2}$$
