[01 – 3112]

III/IV B.E. DEGREE EXAMINATION.

First Semester

Civil Engineering

FLUID MECHANICS — II

(Common with Civil Environmental Engineering)

(Effective from the admitted batch of 2006–2007)

Time : Three hours Maximum : 70 marks

Question No.1 is compulsory.

Answer any FOUR of the remaining Seven questions.

All questions carry equal marks.

1. (a) Define laminar boundary layer and turbulent boundary layer.

   (b) Why should circulation superimposed on flow past a body cause a lift?

   (c) What are the differences between laminar and turbulent flows?

   (d) Define Sequent depth, alternate depth and critical depth in an open channel.

   (e) What do you understand by

      (i) intensity of turbulence

      (ii) scale of turbulence?

(f) What is induced drag, what factors influence it?

(g) A trapezoidal channel has a bottom width of 0.6 m and side slopes are 1:1 and the depth of flow is 1.5 m a discharge of 15 m^3/s. Determine the specific energy.

2. (a) What do you mean by separation of boundary layer? What is the effect of pressure gradient on boundary layer separation?

(b) Air flows over a plate of 600 mm length and 800 mm width with velocity of 5 m/s and Kinematic viscosity $0.15 \times 10^{-4} m^2/s$. Find

(i) Boundary layer thickness at the end of the plate

(ii) Shear stress at 300 mm from the leading edge and

(iii) Drag force on one side of the plate. The velocity profile is assumed to be of the form. $\frac{u}{v} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$.

3. (a) Derive a relation between average velocity and maximum velocity for a steady laminar flow between two fixed parallel plates.

(b) Oil of viscosity 0.1 Pa.s and specific gravity 0.90, flows through a horizontal pipe of 25 mm diameter. If the pressure drop per metre length of the pipe is 12k Pa determine

(i) rate of flow in N/min

(ii) the shear stress at the pipe wall and

(iii) the Reynolds number of the flow.

4. (a) What are semi empirical theories of turbulence? Explain the concept of Mixing length introduced by Prandtl.

(b) Natural gas of density 0.675 kg/m^3 and viscosity 1.226 $\times 10^{-4}$ poise is pumped through a 40 cm diameter pipe at the rate of 6000 N/min. If the average height of pipe roughness is 1.35 mm, examine whether the pipe is hydrodynamically smooth or rough. Calculate the thickness of laminar sub-layer, velocity and shear stress 4cm from the pipe wall. use Karman Prandtl's resistance equation to determine the friction factor.

5. (a) What is meant by Magnus effect? Derive expression for lift force acting on rotating cylinder?

(b) A jet plane which weighs 30 kN and has a wing area of 20 m^2 flies at a velocity of 250 km/hr. When the engine delivers 7357.5 kW, 65% of the power is used to overcome the drag resistance of the wing. Calculate the coefficient of lift and coefficient of drag for the wing. Take density of air equal to 1.21 kg/m^3.

6. (a) Derive expression for loss of head in a hydraulic jump in a rectangular channel in terms of initial and sequent depths.

(b) For a hydraulic jump in a rectangular channel, the velocity and depth after the jump are 0.8 m/s and 1.75 m respectively. Calculate the depth before the jump, the energy loss and power dissipated per metre width.

7. (a) What is specific energy curve? Draw specific energy curve, and then derive expressions for critical depth and critical velocity.

(b) At the bottom of the spillway the velocity and the depth of flow are 12.0 m/s and 1.5 m respectively. If the tail water depth is 5.5m, find the location of the jump with respect to toe of the spillway. What should be the length of the apron to contain this jump? Assume the apron to be horizontal and Manning's $n = 0.015$.

8. Write short notes on the following : $(4 \times 3\frac{1}{2} = 14)$

(a) Lift characteristics of Airfoils.

(b) Mechanism of turbulence.

(c) Hydraulically efficient channel section.

(d) Direct step method for computation of GVF profiles.
