53 (CE 605) HYEN

2014

HYDRAULIC ENGG.

Paper : CE 605

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer ***any five*** *questions.*

1. *(a)* Define laminar boundary layer, turbulent boundary layer, laminar sub layer and boundary layer thickness. 4

   (b) Define displacement thickness. Derive an expression for the displacement thickness. 10

   (c) Derive an equation for most economical trapezoidal section. 6

2. *(a)* Define and explain Newton's law of viscosity. 8

(b) A plate $0{\cdot}025mm$ distant from a fixed plate moves at $60cm/sec$ and requires a force of $2N$ per unit area to maintain this speed. Determine the fluid viscosity between the plates. 2

(c) Prove that the loss of energy head in hydraulic jump is equal to $(d_2 - d_1)^3 / 4_{d_1 d_2}$. 10

3. (a) Derive an expression for Prandtl universal velocity distribution for turbulent flow in pipe. 15

(b) Find the Kinematic Viscosity of an oil having density $981\ kg/m^3$. The shear stress at a point in oil is $0{\cdot}2452\ N/m^2$ and velocity gradient at that point is $0{\cdot}2$ per *second*. 5

4. (a) Find the discharge of water flowing over a rectangular notch at $2m$ length when the constant head over the notch is $300mm$, take $cd = 0{\cdot}60$. 5

(b) Obtain the Von Karman momentum integral equation. 15

5. *(a)* For the velocity profile for laminar boundary layer flows given as

$$\frac{u}{U} = 2(Y/\delta) - (Y/\delta)^2$$

find an expression for boundary layer thickness (δ), Shear stress (τ_0) and coefficient of drag (CD). 15

(b) Prove that the coefficient of lift for a rotating placed in a uniform flow is given by 5

$C_L = \frac{\Gamma}{RU}$, Where Γ = circulation

R = Radius of cylinder

U = Free stream velocity

6. *(a)* The discharge of a water through a rectangular channel of width $6m$ is $18\, m^3/sec$ when the depth of flow of water is $2m$. Calculate

(i) Specific energy of the flowing water

(ii) Critical velocity 12

(iii) Critical depth

(iv) Minimum Specific energy.

(b) Find the Bed Slope of trapezoidal channel of bed width $4m$, depth of water $3m$ and side slope of 2 horizontal to 3 vertical, when the discharge through the channel is $20 m^3/sec$. Take $N = 0{\cdot}03$. 6

(c) What is magnus effect ? 2

7. (a) Obtain an expression for velocity distribution in turbulent flow for 8

(i) Smooth pipe

(ii) Rough pipe

(b) Experiment were conducted in a wind tunnel with a wind speed of 50 *kmph* on a Flat Plate of size $2m$ long and $1m$ wide. The density of air is $1{\cdot}15\ kg/m^3$. The coefficient of lift and drag are $0{\cdot}75$ and $0{\cdot}15$ respectively.

Determine : 12

(i) Lift force

(ii) Drag force

(iii) The resultant force

(iv) Direction of resultant force

(v) Power exerted by air on the plate.
