53 (CE 605) HYEN

2016

HYDRAULIC ENGG.

Paper : CE 605

Full Marks : 100

Time : Three hours

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

*Answer **all** questions.*

1. Answer the following questions : 10×2=20

   (a) Write down the definition with an example of gradually varied flow and rapidly varied flow.

   (b) What do you mean by specific energy ?

   (c) What do you mean by Water hammer ? Also write down the condition for gradual and sudden closure.

(d) Draw the flow profile when fluid flow from steep slope to mild slope.

(e) Find out the Chezy's constant using Manning's formula.

(f) Find out the critical depth and specific energy at critical depth for a rectangular channel with channel width 'B' and water depth 'y'.

(g) Draw the different flow profile for steep slope and critical slope.

(h) The water is flowing with a velocity of 1·5 m/s in a pipe of length 2500m and diameter 500mm. At the end of pipe a valve is provided. Find the rise in pressure if valve is closed in 25sec. Take $C = 1460 m/s$.

(i) What do you mean by nominal boundary thickness and momentum thickness.

(j) Write down a short description about boundary layer separation with proper figure.

2. *(a)* Derive the velocity distribution equation for turbulent flow in smooth pipe,

i.e. $\frac{u}{u_*} = 5{\cdot}75\ log_{10}\left(\frac{u_* y}{\nu}\right) + 5{\cdot}55$

where, u_* = shear velocity, y = vertical distance from boundary and ν = kinematic viscosity of fluid.

(b) A spillway discharges flood flow at a rate of $7{\cdot}75\, m^3/s$/per meter width. At the down stream horizontal apron the depth of flow was found to be $0{\cdot}5m$. What tail water (y_2) is needed to form a hydraulic jump ?

If a jump is formed, find its *(i)* type *(ii)* head loss *(iii)* energy loss as a percentage of initial energy.

10+10=20

3. *(a)* Water is flowing in a long pipe which is $0{\cdot}15m$ diameter and $6{\cdot}25mm$ thick with a velocity of $1{\cdot}2m/s$ and it is suddenly brought to rest by the closing of a valve. Calculate the inertia pressure and the theoretical stress produced in the pipe near the valve.

Take 'K' for water = $207\times10^4\ kN/m^2$ and E for pipe material=$206\times10^6 kN/m^2$.

(b) A hydraulic jump takes place in a rectangular channel with sequent depth of $0{\cdot}25m$ and $1{\cdot}50m$ at the begining and end of the jump separately. Estimate *(i)* discharge per unit width of channel and *(ii)* energy loss.

10+10=20

4. (a) If y_1 and y_2 are alternate depth in a rectangular channel then show that $y_c^3 = 2y_1^2 y_2^2/(y_1 + y_2)$ and

$$E = \frac{y_1^2 + y_1 y_2 + y_2^2}{(y_1 + y_2)}$$

where, y_c = critical depth of channel and E = specific energy.

(b) Using Buckingham Π theorem, show that velocity through a circular orifice is given by

$$V = \sqrt{2gh}\ \phi[D/H, \mu/\rho vH]$$

where H=head causing flow, D=orifice diameter, μ = coefficient of viscosity, ρ = mass density and g = acceleration due to gravity.

10+10=20

5. *(a)* Air flows at $10m/s$ past a smooth rectangular flat plate $0{\cdot}3m$ wide and $3m$ long. Assuming that the turbulence level in the oncoming stream is low and that transition occurs at Reynolds number $(=5\times10^5)$. Calculate ratio of total drag when the flow is parallel to the length of plate to the valve when the flow is parallel to width.

Assume density of air is $1{\cdot}24 kg/m^3$ and Kinematic viscosity of air is 0·15 stokes.

(b) The pressure drop in an aeroplane model of size $\frac{1}{40}$ of its prototype is $80\,N/cm^2$. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air is $1{\cdot}24\,kg/m^3$. The viscosity of water is 0·01 poise while viscosity of air is 0·00018 poise.

10+10=20
