53 (CE 605) HYEN

2019

HYDRAULIC ENGINEERING

Paper : CE 605

Full Marks : 100

Time : Three hours

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

*Answer **all** questions.*

1. A sharp flat plate with length and width are $1m$ and $3m$ respectively, is immersed parallel to a stream of velocity $2m/s$. Find the drag on one side of the plate and also at the trailing edge, find the displacement, momentum and energy thickness for

   (i) air, density = 1.23 kg/m^3 and kinematic viscosity = 1.46×10^{-5} m^2/s.

   (ii) water, density = 1000 kg/m^3 and kinematic viscosity = $1.02\times10^{-6} m^2/s$.

   10

Contd.

2. A flat plate, $1.5m \times 1.5m$ moves at $50km$ per hour in stationary air of density 1.15 kg/m^3. If coefficient of drag and lift are 0.15 and 0.75 respectively then determine —

(i) lift force, *(ii)* drag force, *(iii)* resultant force, *(iv)* power required to keep the plate in the motion. 10

3. Derive the dynamic equation for gradually varied flow. 10

4. The ratio of lengths of submarine and its model is 30 :1. The speed of submarine is $10m/s$. The model is tested in wind tunnel. Find the speed of air in wind tunnel.

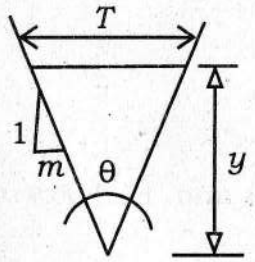
Also, determine the ratio of drag between model and prototype. Take the value of kinematic viscosity for sea water and air as 0.012 stokes and 0.016 stokes respectively. The density for sea water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively. 10

5. Water is flowing through rough pipe of diameter $8cm$. Velocity at a point $3.0cm$ from wall is 30% more than velocity at a point 1 cm from pipe wall. Determine the average height of roughness. 10

6. Write down the properties of turbulent flow. What do you mean by Nikuradse's equivalent roughness ? Write in detail about hydraulically smooth and rough flow. 2+4+4=10

7. Distinguish between deformation drag, surface drag and form drag. In case of sphere, discuss their relative importance at various increasing values of Reynolds number. 10

8. Find out the critical depth and specific energy at critical depth for a triangular channel. 10



9. Water is flowing with a velocity '*v*' *m/s* in a pipe of length '*L*' *m* and diameter '*D*' *mm*. At the end of pipe a valve is provided. If the thickness of pipe is '*T*' *mm* and valve is suddenly closed at the end of pipe, then derive the required mathematical expression for the rise in pressure in pipe, when pipe is considered to be elastic.

Assume modulus of rigidity of pipe is 0.25. 15

10. Write a short note on "Efficiencies of turbine." 5
