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K – 4253

Reg. No. : .....

Name : .....

Fourth Semester B.Tech. Degree Examination, September 2020

13.404 : FLUID MECHANICS – II (C)

(2013 Scheme)

Time : 3 Hours

Max. Marks : 100

PART – A

Answer **all** questions. Each question carries **4** marks.

1. (a) Derive a relation between Chezy's and Manning's constants
   (b) Explain the different types of hydraulic jump.
   (c) Derive the dynamic equation of gradually varied flow.
   (d) Differentiate between laminar boundary layer and laminar sub layer.
   (e) Explain the effect of cavitation in centrifugal pumps.

(5 × 4 = 20 Marks)

PART – B

Answer **any one full** questions from **each** Module. Each question carries **20** marks.

2. (a) Derive the conditions for a hydraulically efficient rectangular channel section. **10**

   (b) A rectangular channel 7.5 m wide carries $12m^3$ of water per second with a velocity of 1.5m/sec. Compute the specific energy. Also find the depth of flow in the channel when the specific energy would be minimum. What will be the value of critical velocity as well as minimum specific energy? **10**

OR

P.T.O.

3. (a) A trapezoidal channel is to be designed to convey 50 m^3/s of water at a velocity of 2 m/s. The bed width to depth ratio is to be 8 and the side slopes are to be 1 H :1 V. It will be lined with a material whose Manning's n = 0.02. calculate the bed width, depth of flow and slope of the channel. **10**

(b) The cross-section of an open channel consists of semi-circular bottom 1.2 m in diameter and with vertical sides. If the rate of flow is 0.402 m^3/s and the bed slope is 1 in 2500, calculate the centre line depth of water. Assume manning's n=0.011. **10**

4. (a) Derive an equation for the absolute velocity and celerity of a positive surge wave. **10**

(b) At a certain section M in rectangular channel of bed width 2 m the depth of flow is 1.2m. When the flow rate is 6 m^3/s, estimate the distance from M to another section N where the depth is 1.4m. The bed slope is 0.002 and Manning's n = 0.015. Take two steps in step method. **10**

OR

5. (a) A triangular channel with side slope 1 H :1 V and longitudinal slope of 0,001 discharges water at a rate of 0.2 m^3/sec. Determine whether the channel is mild, steep or critical. Assume Manning's n = 0.015. For what range of depths will the flow be on a type 1,2 or 3 curve? **10**

(b) A 2 m wide rectangular channel has a flow with a velocity of 2 m/s and depth of 1.3 m. The rate of inflow at the upstream end is suddenly increased to an extent that the depth is doubled in magnitude. Estimate the absolute velocity of the resulting surge and the new discharge. **10**

6. (a) Explain Buckingham's π-Theorem. **8**

(b) Air flows over a plate 1 m long at a velocity of 6 m/sec. Determine the

(i) boundary layer thickness at the end of the plate,

(ii) shear stress at the middle of the plate, and

(iii) total drag per unit length on the sides of the plate. Take the kinematic viscosity of air as 0.15 stokes. **12**

OR

7. (a) In order to estimate the energy loss in a pipeline of 1 m diameter, through which kerosine of specific gravity 0.8 and dynamic viscosity 0.02 poise is to be transported at the rate of 2 m^3 per second, model tests were conducted on a 0.1 m diameter pipe using water at 20°C. Calculate the discharge required for the model pipe. If the energy head loss in 30m length of the model pipe is measured as 4.8 m of water, determine the corresponding head loss in the prototype. Also determine the value of Darcy's friction factor for the prototype. Given the kinematic viscosity of water = 0.01 poise. **12**

(b) A model boat, 1:100 size of its prototype has 0.12 N of resistance when simulating a speed of 5 m/s of the prototype. Water is the fluid in both cases. What is the corresponding resistance in the prototype? Neglect the frictional forces. **8**

8. (a) A jet of water having a velocity of 40 m/s strikes a curved vane, which is moving with a velocity of 20 m/s. The jet makes an angle of 30 degree with the direction of motion of vane at inlet and leaves at an angle of 90 degree to the direction of motion of vane at outlet. Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet? **12**

(b) What is a draft tube? Explain the different types of draft tubes with sketch. **8**

OR

9. (a) Derive the expression for specific speed of a certrifugal pump. **6**

(b) A pelton wheel is to be designed for the following data.

Power to be developed = 500kW, Net available need = 290m, Speed = 500 r.p.m, Ratio of jet diameter to wheel diameter = $\frac{1}{8}$, overall efficiency 82%. Find the number of jet, diameter of the jet diameter of the wheel and the quantity of water required? Also determine the hydraulic efficiency of the Pelton wheel? **14**
