Fourth Semester B.E. Degree Examination, June/July 2017
Applied Hydraulics

Time: 3 hrs. 　　　　　　　　　　　　　　　　　　　　　　Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. What is meant by dimensionally homogeneous equation? Explain with an example.
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(04 Marks)
　 b. Define i) Center of buoyancy ii) Metacenter. How these are used to identify the equilibrium condition of floating bodies? 　　　　　　　　　　　　　　　　(06 Marks)
　 c. In a 1:30 model of spillway, the velocity and discharge are 1.5m/s and 2m³/s. Find the corresponding velocity and discharge in prototype. 　　　　　　　　(06 Marks)

OR

2 a. Using Buckingham π-theorem, derive the following relationship

$$R = \rho V^2 D^2 . \ \phi\left[\frac{\mu}{\rho VD}, \frac{H}{D}\right]$$

　　Where R = Resistance, ρ = density, V = Velocity of flow, D = diameter, μ = Viscosity, H = hight. 　　　　　　　　　　　　　　　　　　　　　　　　(07 Marks)
　 b. Define :
　　i) Geometric similarity　　ii) Kinematic similarity and　　iii) Dynamic similarity.　(06 Marks)
　 c. A body of cross-sectional area 2m² and depth 5m has specific gravity 0.8. Determine the depth of immersion of the body. 　　　　　　　　　　　　　　　(03 Marks)

Module-2

3 a. Derive Chezy's equation for discharge through uniform flow in open channel.　(08 Marks)
　 b. A 3m wide rectangular channel carries 2.4m³/s discharge at a depth of 0.7m. Determine:
　　i)　　Specific energy at 0.7m depth
　　ii)　　Critical depth
　　iii)　　Alternate depth to 0.7.　　　　　　　　　　　　　　　　　　(08 Marks)

OR

4 a. For the most economical trapezoidal section show that half of top width is equal to side slope length. 　　　　　　　　　　　　　　　　　　　　　　　(08 Marks)
　 b. A rectangular channel 6m wide and 1m depth of water has a bed slope of 1 in 900 and is having n = 0.012. Determine the discharge. What will be the dimensions of the channel for maximum discharge with amount of lining being kept constant? Also compute percentage increase in discharge. 　　　　　　　　　　　　　　　　(08 Marks)

Module-3

5 a. Derive the relationship between conjugate depths in case of hydraulic jump on a horizontal floor. 　　　　　　　　　　　　　　　　　　　　　　　　(08 Marks)
　 b. A rectangular channel with bottom width 4m and bed slope 0.0008 has a discharge of 1.5m³/s. In a GVF in this channel the depth at a certain section is 0.3m. If n = 0.016, determine the type of profile. 　　　　　　　　　　　　　　(08 Marks)

OR

6 a. Explain the classification of surface profiles in an open channel with neat sketches.

(10 Marks)

b. A rectangular channel 8m wide discharges water with a depth of 0.4m and 6m/s velocity. Find the formation of hydraulic jump and if so, determine jump height and energy loss in meters. (06 Marks)

Module-4

7 a. Show that the maximum efficiency of jet striking at the center of a symmetrical single curved vane is $\left(\dfrac{16}{27}\right)$. vane is semicircular. (08 Marks)

b. A Pelton wheel turbine has to be designed for the following :
Data: Power = 6000kW, Net head = 300m, Speed = 550rpm, Jet ratio = 1/10, Overall efficiency = 85%, C_v = 0.98, Speed ratio is 0.46. Determine diameter of runner and jet, discharge and number of jets required. (08 Marks)

OR

8 a. Draw a neat sketch of a layout of hydroelectric power plant and explain the functions of each component. Also define different heads. (08 Marks)

b. A jet of water moving at 30m/s impinges on a series of curved vanes moving with a velocity of 15m/s. The jet makes an angle of 30° to the direction of motion of vane when entering and leaves at an angle of 120° to the direction of motion of vanes. Draw the velocity triangles at inlet and outlet and find :
   i)   The vane angle at inlet and outlet
   ii)   Workdone per N of water
   iii) Hydraulic efficiency. (08 Marks)

Module-5

9 a. Define :
   i)   Unit head   ii) Unit discharge   iii)   Unit power. (03 Marks)

b. Derive the expression for minimum starting speed of a centrifugal pump. (06 Marks)

c. A Kaplan turbine runner is to be designed to develop 7350kW power under a head of 5.5m with $\eta_0 = 85\%$. Boss diameter = $\dfrac{1}{3}$ diameter of runner, speed ratio = 2.1, Flow ratio = 0.7.
Determine :
i) Diameter of runner and boss,   ii) Speed. (07 Marks)

OR

10 a. Define draft tube. Explain its function. Draw the neat sketches of types of draft tubes. (06 Marks)

b. Define: i) Manometric head   ii) Static head   iii) Suction head   iv) Delivery head. (04 Marks)

c. A centrifugal pump runs at 1000rpm and delvers water against a head of 15m. The impeller diameter and width at the outlet are 0.3m and 0.05m respectively. The vanes are curved back at 30° $\eta_{man} = 92\%$. Find discharge. (06 Marks)

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