CBCS Scheme

USN | | | | | | | | | | 15CV43

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Applied Hydraulics

Time: 3 hrs. Max. Marks: 80

Note: **1.** ***Answer any FIVE full questions, choosing one full question from each module.***
2. ***Assume missing data suitably.***

Module-1

1 a. Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\,\phi\left(\frac{D}{H}, \frac{\mu}{\rho VH}\right)$, where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(10 Marks)**

b. A pipe of diameter 1.5 m is required to transport an oil of specific gravity 0.9 and viscosity 3×10^{-2} poise at the rate of 3000 *l*/s. Tests were conducted on a 15 cm diameter pipe using water at 20°C. Find the viscosity and rate of flow in the model. Viscosity of water at 20°C = 0.01 Poise. **(06 Marks)**

OR

2 a. A solid cylinder of diameter 4 m has a height of 4m. Find the meta centric height of the cylinder, if the specific gravity of the material of cylinder = 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. **(08 Marks)**

b. A 1:40 model of an ocean tanker is dragged through fresh water at 2 m/s with a total measured drag of 12 N. The skin drag coefficient 'f' for model and prototype are 0.03 and 0.002 respectively in the equation $R_f = f.AV^2$. The wetted surface are of the model is 25 m^2. Determine the total drag on the prototype and power required to drive the prototype. Take $\rho_p = 1030$ kg/m^3 and $\rho_m = 1000$ kg/m^3. **(08 Marks)**

Module-2

3 a. What is meant by economical section of a channel? Derive the condition for the most economical rectangular section. **(08 Marks)**

b. The discharge of water through a rectangular channel of width 8m is 15 m^3/s. When depth of flow of water is 1.2 m, calculate:
i) Specific energy of the flowing water.
ii) Critical depth and critical velocity
iii) Value of minimum specific energy **(08 Marks)**

OR

4 a. Define specific energy, draw specific energy curve and then derive expressions for critical depth and critical velocity. **(08 Marks)**

b. Find the diameter of a circular sewer pipe which is laid at a slope of 1 in 8000 and carries a discharge of 800 *l*ps when flowing half full. Take the value of Manning's N = 0.02. **(08 Marks)**

Module-3

5 a. A hydraulic jump forms at the downstream end of spillway carrying 17.93 m^3/s discharge. If the depth before jump is 0.8m, determine the depth after the jump and energy loss. Consider 1 m width of channel. **(06 Marks)**

b. Determine the length of the back water curve caused by an afflux of 2m in a rectangular channel of width 40 m and depth 2.5 m. The slope of the bed is given as 1 in 11000. Take Manning's N = 0.03. **(10 Marks)**

OR

6 a. Find the slope of the free water surface in a rectangular channel of width 20 m having a depth of flow 5m. The discharge through the channel is 50 m^3/s. The bed of the channel is having a slope of 1 in 4000. Take the value of Chezy's constant C = 60. **(08 Marks)**

b. What is gradually varies flow and derive an expression for gradually varied flow? Also mention the assumptions mode for derivation. **(08 Marks)**

Module-4

7 a. A jet of water strikes an unsymmetrical moving curved vane tangential at one of the tips. Derive an expression for the force exerted by the jet in the horizontal direction of motion of vane. Also describe the velocity and obtain the expression for work done per second and efficiency. **(08 Marks)**

b. Draw a neat sketch of hydroelectric power plant and mention the function of each component. **(08 Marks)**

OR

8 a. A pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 *l*/s under a head of 30 m. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume coefficient of velocity as 0.98. **(08 Marks)**

b. Give a detailed classification of turbines. Also discuss about different heads and efficiencies. **(08 Marks)**

Module-5

9 a. Draw a neat sketch of Kaplan turbine and explain the function of each part in brief. **(08 Marks)**

b. Derive an expression for the minimum starting speed of a centrifugal pump. **(08 Marks)**

OR

10 a. A Francis turbine with overall efficiency of 75% required to produce 148.25 KW power. It is working under a head of 7.62 m. The peripheral velocity = $0.26\sqrt{2gh}$ and radial velocity of flow is $0.96\sqrt{2gh}$. The wheel runs at 150 rpm and hydraulic losses in the turbine are 22% of the available energy. Assume radial discharge. Determine:

i) Guide blade angle at the inlet
ii) The wheel vane angle at the inlet
iii) Diameter of the wheel at the inlet
iv) Width of the wheel at the inlet **(08 Marks)**

b. Define multistage centrifugal pump and with neat sketch, explain the multistage centrifugal pumps used for (i) high heads (ii) high discharge. **(08 Marks)**

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