4E4113

Roll No

Total No of Pages: 4

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B.Tech. IV-Sem (Main & Back) Exam; June-July 2016

Civil Engineering

4CE3A Hydraulics & Hydraulic Machines

Time: 3 Hours

Maximum Marks: 80

Min. Passing Marks (Main & Back): 26

Min. Passing Marks (Old Back): 24

Instructions to Candidates:-

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/ calculated must be stated clearly.

Use of following supporting material is permitted during examination.

(Mentioned in form No: 205)

1 NIL

2 NIL

UNIT-I

Q.1 (a) Prove that velocity through an orifice can be expressed as [10]

$$V = \sqrt{2gH}\ \Phi\left[\frac{D}{H}, \frac{\mu}{\rho V H}, \frac{\sigma}{\rho V^2 H}\right]$$

Where H is the head causing flow, D is the diameter of the orifice, μ is the coefficient of viscosity, ρ is the mass density and σ is the surface tension.

(b) What do you understand by Distorted Model? Give a suitable example for distortion. [6]

OR

Q.1 (a) Define the following-

(i) Froude's number [2]

(ii) Mach's number [2]

(iii) Weber's number [2]

(iv) Euler's number [2]

(b) A pipe of diameter 1.8m is required to transport an oil of specific gravity 0.8 and viscosity of 4×10^{-2} poise at the rate of 4 m^3/s. The tests were conducted on a 20 cm dia. Pipe using water at 20°C. Find the velocity and rate of flow in the model. Viscosity of water at 20°C is 1×10^{-2} poise. [8]

UNIT-II

Q.2 Derive Hagen – Poiseulli's equation for laminar flow in pipes. Also derive the relationship between

(a) Darcy's friction coefficient 'f' and Reynolds's number 'N_R'. [8]

(b) Wall shear stress and Darcy's coefficient 'f' state the assumption also. [8]

OR

Q.2 For the velocity profile given by: [16]

$$\frac{V}{V_o} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$$

for the laminar boundary layer determine the expression for boundary layer thickness, wall shear stress and coefficient of drag in terms of Reynolds's number.

Explain in brief the methods of controlling boundary layer.

UNIT-III

Q.3 (a) A wide channel laid to a slope of 1 in 1000 carries a discharge of 3.5 m^3/s per meter width at a depth of 1.6m: [10]

(i) Find the value of Chezy's constant 'C' assuming the flow to be uniform.

(ii) If the depth varies gradually from 1.5 m to 1.7 m at a location 300m downstream, what will be the value of 'C'.

(b) Derive the condition of most economical trapezoidal section. [6]

OR

Q.3 (a) Explain the various types of surface curves with the help of neat sketches. [8]

(b) The discharge of water through a rectangular channel of width 8m, is 15 m^3/s when depth of flow of water is 1.2m. Determine- [8]

(i) Specific energy of the flowing water

(ii) Critical depth and critical velocity

(iii) Minimum specific energy

UNIT-IV

Q.4 (a) A jet of water having a velocity of 60 m/s impinges without shock on a series of vanes moving at 30m/s. The direction of motion of vanes is inclined at 20° to that of jet. The relative velocity at outlet is 0.9 of that at inlet and flow is radial at exit. Find out- [8]

(i) Vane angles at inlet and exit

(ii) Work done by the vanes

(iii) Hydraulic efficiency

(b) Show that the efficiency of a free jet striking normally on a series of flat plates mounted on the periphery of a wheel can never exceed 50%. [8]

OR

Q.4 (a) Derive a relationship for depth before and after the hydraulic jump in a rectangular channel state the assumption mode. [8]

(b) At the foot of a 30m wide spillway from a dam when the discharging velocity is 28.2m/s and the depth of flow is 0.96m, a hydraulic jump is formed on a horizontal apron. Calculate the height and energy dissipated in the jump. [8]

UNIT-V

Q.5 (a) A centrifugal pump operating against a manometric head of 35m has a manometric efficiency of 0.85. Radial velocity of flow is constant throughout. The increase in pressure over the impeller is 65% of the theoretical head developed by the pump. Determine:

(i) Speed

(ii) Discharge

The impeller outer diameter is 16cm and breadth is 16mm. The moving vane angle at exit is 60°. Neglect impeller losses. [10]

(b) What do you mean by cavitation in turbines? What are its effects and explain the methods of prevention of cavitation. [6]

OR

Q.5 (a) Give reasons for the following-

(i) In reaction turbines and centrifugal pumps, the relative velocity vector is tangential to the blades. [2]

(ii) Kaplan turbine has high port load efficiency. [2]

(iii) Draft tubes are provided only for reaction turbines and not impulse turbines. [2]

(iv) Centrifugal pumps have comparatively lower efficiencies than reaction turbines. [2]

(b) A Kaplan turbine develops 22000 kW at an average head of 35m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of the boss equal to 0.35 times the diameter of runner and an overall efficiency of 88%. Calculate the diameter, speed and specific speed of the turbine. [8]