(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 100403	**Roll No.**										

B.Tech.

(SEM. IV) THEORY EXAMINATION 2013-14

HYDRAULICS AND HYDRAULIC MACHINES

Time : 3 Hours *Total Marks : 100*

Note : (1) This question paper has **three** Sections A, B and C.

(2) Attempt all questions.

(3) Marks and number of questions to be attempted from each section is mentioned before the section.

(4) Assume missing data suitably.

SECTION–A

1. This section has **ten** parts of short answer type questions. Attempt **all** parts : **(2×10=20)**

(a) Differentiate between uniform and non-uniform flow; laminar and Turbulent flow.

(b) Discuss velocity distribution in an open channel.

(c) Differentiate between most economical and most efficient channel.

(d) Distinguish between GVF and RVF.

(e) Explain the terms :

(i) Hydraulic mean depth.

(ii) Wetted perimeter.

(f) Explain the term hydraulic jump.

(g) A pelton wheel operates at 630 rpm taking 3 m^3/s of water under a head of 256 m with a speed ratio of 0.48. What is the diameter of the impeller ?

(h) Differentiate between the impulse turbine and reaction turbine with example.

(i) Define a centrifugal pump.

(j) Describe the Chezy's and Manning's equations for uniform flow in open channel.

SECTION–B

2. Attempt any **five** parts of the following : **(5×6=30)**

(a) Differentiate between open channel flow and pipe flow, show the energy grade line and the hydraulic grade line in both cases.

(b) Explain the specific energy concept and prove the critical flow condition for all type of channel.

(c) Define the term Reynold's number and Froude's number. Differentiate between Tranquil and Torrential flow in open channel.

(d) Derive continuity equation for unsteady flow. Also arrive at the expression for rectangular channel.

(e) What is a draft tube ? Why is it used in a reaction turbine. Describe with neat sketches.

(f) What is priming of a centrifugal pump ? Why is it necessary ?

(g) What is the difference between single stage and multistage pumps ?

SECTION–C

Note :– Question Nos. 3 to 7 have **three** parts each. Attempt any **two** parts from each question. **(5×10=50)**

3. (a) A triangular channel has an apex angle of 60° and carries a flow with a velocity of 2.0 m/s and depth of 1.25 m.

(i) Is the flow sub-critical or supercritical ?

(ii) What is the specific energy at critical depth ?

(b) Derive the condition for most efficient Trapezoidal channel section for uniform flow.

(c) A concrete-lined Trapezoidal channel ($n = 0.015$) is to have a side slope of 1.0 Horizontal : 1 Vertical. The bottom slope is to be 0.0004. Find the bottom width of the channel necessary to carry 100 m^3/s of discharge at a normal depth of 2.50 m.

4. (a) A rectangular channel flow has bed slope of 0.001, Width = 3 m and Manning coefficient $\eta = 0.015$, discharge 1 m^3/s, given that normal depth of flow ranges between 0.76 m and 0.8 m. Find the minimum width of Throat that is possible at a given section while ensuring that the prevailing normal depth does not exceed along the reach upstream of the concentration. (Assume negligible loss)

(b) Draw and discuss M_1, M_3, S_1 and S_3 Flow profile.

(c) A very wide Rectangular channel carries a discharge $8 m^3/s$ per meter width. The channel has bed slope of 0.004 and Manning Roughness Coefficient $\eta = 0.015$ at a certain section of channel, the flow depth is 1 m.

(i) Which type of GVF profile exists at section.

(ii) At what distance from the section will the flow depth be 0.9 m (Use direct step method)

5. (a) A spillway discharges flood flow at a rate of 7.75 m^3/s per meter width. At the downstream horizontal apron the depth of flow was found to be 0.50 m. What tailwater depth is needed to form a hydraulic jump ? If jump is formed, find its :

(i) Type

(ii) Length

(iii) Head loss.

(b) A 3.0 m wide Rectangular channel has a flow of 3.60 m^3/s with a velocity of 0.8 m/s. If sudden release of additional flow at the upstream end of the channel causes the depth to rise by 50 %, determine absolute velocity of the resulting surge and new flow rate.

(c) A Rectangular channel has a width of 2.0 m and carries a discharge of 4.80 m^3/s with a depth of 1.60 m. at a certain section a small, smooth hump with a flat top and of height 0.50 m is proposed to be built. Calculate the likely change in the water surface. Neglect the energy loss.

6. (a) A Francis turbine works at 450 r.p.m under a head of 120 m. If diameter at inlet is 1.20 m and flow area at inlet is 0.4 m^2. The angle made by Absolute and Relative velocity with Tangent of Runner at inlet are 20° and 60°. Determine flow rate, Runner power developed and Hydraulic Efficiency. Assuming whirl velocity at outlet is zero.

(b) Distinguish between deep and shallow water waves.

(c) What is reciprocating pump ? Describe the principle and working of a reciprocating pump with a neat sketch.

7. (a) The centrifugal pump having outer diameter equal to two times inner diameter is running at 1000 rpm with working head of 40 m. Velocity of flow is constant and equal to 2.5 m/s . The vanes are set back at an angle of 40° at outlet. If outer diameter of Impellar is 50 cm and the width at outlet is 5 cm. Then determine vane angle at inlet, impellar power and manometric efficiency. Assume waters enter radially at inlet.

(b) A Pelton wheel has a mean bucket speed of 10 meters per second with a jet of water flowing at the rate of 700 liters/s under a head of 30 metres. 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.

(c) Prove that work done per second per unit weight of water in a reaction turbine is given as :

$$\frac{1}{g}(V\omega_1 U_1 \pm VW_2 U_2)$$

where VW_1 and VW_2 = Velocities of whirl at inlet and outlet.