(b) What are conditions for a trapezoidal channel to be most economical section? Derive any two conditions.

(c) A rectangular channel is 3.0 m wide and carries a flow of 1.85 cumecs at a depth of 0.50 m. The construction of the channel width is required at a certain section. Find the greatest allowable contraction in the width for the upstream flow to be possible, as specified.

3. Attempt any two parts of the following: (10x2=20)

(a) Enumerate and explain with neat sketches, classification of surface profiles in case of gradually varied flow. Also, how can you classify channel slope?

(b) (i) Show that gradually varied flow equation for flow in a rectangular channel of variable width B is expressed as:

$$\frac{dy}{dx} = \frac{S_0 - S_f + \left(\frac{Q^2 y}{gA^3}\right)\frac{dB}{dx}}{1 - \frac{Q^2 B}{gA^3}}$$

(ii) Describe numerical integration method for computation of gradually varied flow in a prismatic channel.

(c) A rectangular channel of width 10 m bed slope 1:145 and a roughness factor of 0.021. If the normal depth is 1.45 m, what is the normal discharge? The depth of flow in the channel increases of 3.5 m behind a low dam in the channel. How far upstream of the dam is a depth of 2.1 m likely to occur? Use one step direct method. Identify the type of gradually varied flow profile?

4. Attempt any two parts of the following: (10x2=20)

(a) Define Hydraulic jump. Write their uses. Describe with neat sketches, types of hydraulic jump on the basis of Froude number.

(b) An overflow spillway is 55.0 m high. At the design energy head of 2.2 m over the spillway calculate the sequent depths and energy loss in a hydraulic jump formed on a horizontal apron at the toe of the spillway. Neglect energy loss due to flow over spillway face. Take $C_d = 0.738$.

B.Tech. (Main & COP)

Fourth Semester Theory Examination 2016-17

Hydraulics and Hydraulic Machines

Time: 3 Hours **Total Marks: 100**

Note Attempt all questions. Draw diagrams if required.

1. Attempt any four parts of the following: (5x4=20)

(a) Derive the continuity equation for steady flow in an open channel.

(b) Deduce the equation for maximum discharge condition:

$Q^2/g = A^3/T$.

(c) A trapezoidal channel with side slopes of 2(H):1(V) has to be designed to carry a discharge of 25 m^3/s at a slope of 1/4500. Determine the depth of flow. Given Bottom width 2.5 m and Manning's coefficient $n = 0.015$.

(d) Velocity distribution in an open channel is given by:

$U = 1.5 + (y/y_0)$

Where U is the velocity at a depth of y from the bottom and y_0 is the total depth of flow, calculate the kinetic energy correction factor (α) and momentum correction factor (β).

(e) An open channel of V-shaped has each side inclined at 45^0 to the vertical. It carries a discharge of 0.05 cumecs, when the depth of flow in the channel is 3.0 m. calculate the slope of the channel. Assume Chezy's coefficient(c) = 50.

(f) What is the difference between open channel flow and pipe flow? Differentiate between prismatic and non-prismatic channels?

2. Attempt any two parts of the following: (10x2=20)

(a) The discharge of water through a rectangular channel of width 8 m, is 25 cumecs, when depth of flow of water is 1.5 m, calculate:

(i) Specific energy of the flowing water,

(ii) Critical depth, and

(iii) Critical velocity

(c) Give classification of surge with neat sketches. Describe positive surge moving downstream and deduce the expression for the same.

5. **Attempt any four parts of the following:** **(5x4=20)**

(a) Define static and manometric head of a centrifugal pump. State the different type of head losses, which may occur in pump installation.

(b) What are the different parts of rota-dynamic pumps? Describe with neat sketches.

(c) Define the terms: Unit power, unit speed and unit discharge. Obtain an expression for unit speed.

(d) Draw the characteristics curve of a Francis turbine with neat sketches.

(e) A Pelton turbine produces 30000 kW while running at 750 rpm under an effective head of 1200 m. Calculate least diameter of the jet, no. of bucket, mean diameter of runner. Assume $K_v = 0.98$, $n_0 = 0.9$ and $K_u = 0.40$.

(f) A Kaplan turbine develops 20000 kW power under a head of 35 m. Assume an overall efficiency of 85%, velocity ratio of 2.0, flow ratio at 0.65 and diameter of boss equal to 0.35 times the diameter of the runner. Calculate the diameter, speed and specific speed of the turbine.