B.TECH.
THEORY EXAMINATION (SEM–IV) 2016-17
HYDRAULICS AND HYDRAULIC MACHINES

Time : 3 Hours ***Max. Marks : 100***

Note : *Be precise in your answer. In case of numerical problem assume data wherever not provided.*

SECTION – A

1. Explain the following: 10 x 2 = 20

(a) What do you understand by uniform and non-uniform flow in the case of channels?
(b) State and discuss the assumptions made in the derivation of the dynamic equation for gradually varied flow.
(c) Write down the manning's equation for uniform flow in open channel.
(d) Briefly explain in gradually varied flow.
(e) Write down the dynamic equation for gradually varied flow in wide rectangular channel.
(f) Discuss the characteristics of surface profiles.
(g) Explain the working principles of reciprocating pump.
(h) Explain the functions of air vessels in a reciprocating pump.
(i) What are the uses of a draft tube?
(j) Describe the surge tank and a forebay and what are their functions?

SECTION – B

2. Attempt any five of the following questions: 5 x 10 = 50

(a) A trapezoidal channel with a base width of 6m and side slopes of 2horizontal to 1 vertical conveys water at 17m^3/s with a depth of 1.5m.is the flow situation sub or super critical.
(b) State the conditions under which the rectangular section of an open channel will be most economical. Derive these conditions.
(c) At what height from water surface a centrifugal pump may be installed in the following case to avoid cavitation; atmospheric pressure 101kpa;vapour pressure 2.34kpa;inlet and other losses in suction pipe 1.55m;effective head of pump 52.5m;and cavitation parameter σ =0.118.
(d) Show that the maximum inertia head in a reciprocating pump without air vessel is given by

$$H_a = \frac{1}{g} \times \frac{A}{a} \omega^2 r$$

(e) What is Chezy's formula? How is it derived?
(f) Show that for a trapezoidal channel of given area of flow, the condition of maximum flow requires that hydraulic mean depth is equal to one half the depth of flow.
(g) A rectangular channel 10m wide is laid with a break in its bottom slope from 0.01 to 0.0064. If it carries 125m^3/s, determine the nature of the surface profile and compute its length. Take n=0.015.
(h) Explain with neat a sketch, the construction details and working principles of a centrifugal pump.

SECTION – C

Attempt any two of the following questions: 2 x 15 = 30

3. (a) A trapezoidal channel has a bottom width of 6m and side slopes of 1:1 the depth of flow is 1.5m at a discharge of $15m^3/s$.determine the specific energy. If the critical depth is 0.9m, discuss the type of flow corresponding to the critical depth.

(b) For a hydraulic jump in a horizontal triangular channel show that

$$3Fr_1^2 = \frac{r^2(r^3-1)}{r^2-1}$$

where

$$Fr_1^2 = (v_1^2/gy_1)$$

$$r = (y_2/y_1)$$

4. (a) A horizontal rectangular channel 4m wide carries a discharge of $16m^3/s$.Determine whether a jump may occur at an initial depth of 0.5m or not. If a jump occurs, determine the sequent depth to this initial depth. Also determine the energy loss in the jump.

(b) Design a pelton wheel which is required to develop1500kW, when working under a head of 160m at a speed of 420rpm.the overall efficiency may be taken as 85% and assume other data required.

5. An inward flow reaction turbine is required to develop 300kW at 200rpm.the active head at the turbine is 18m.determine the outside and inside diameters, the inlet and exit angles for the vanes and the exit angle for the guide vanes. Assume the inlet diameter equal to twice the outlet diameter, the hydraulic efficiency as 80%, the constant radial velocity of flow of $3.6m^3/s$ through the runner, the mechanical efficiency as 95% and the width ratio as .10, water leaves the runner radially.