Code No: 114AA **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, May - 2017
HYDRAULICS AND HYDRAULIC MACHINERY
(Civil Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A **(25 Marks)**

1.a) Differentiate between subcritical flow and supercritical flow. [2]
b) What is hydraulic jump? [3]
c) State Rayleigh's method of dimension analysis. [2]
d) What are geometric, kinematic and dynamic similarities? [3]
e) State the principle of Angular momentum. [2]
f) Explain Hydraulic efficiency, mechanical efficiency and overall efficiency. [3]
g) Explain about surge tank in turbines. [2]
h) Define specific speed of turbine. [3]
i) Differentiate between single stage and multi stage pump. [2]
j) Define utilization factor and capacity factor. [3]

PART-B **(50 Marks)**

2.a) Derive expression for kinetic energy correction factor.
b) Velocity distribution in an open rectangular channel is given by $V=3y^{½}$. If the width of the channel is 10 m and the depth of flow is 1m, find the average velocity of the cross section, energy correction factor and momentum correction factor. [5+5]

OR

3.a) Define hydraulic jump. Explain various types of hydraulic jump. Derive the head loss in hydraulic jump.
b) A gate is to be suddenly dropped into a place closing a rectangular channel 2 m deep and 3 m wide in which 6 cumec of water is flowing at a depth of 1.2 m. Will the water spill over the sides? What will be the velocity and height of surge produced? [5+5]

4.a) Explain about different types of forces acting in moving fluid.
b) The pressure difference Δp in a pipe of diameter D and length due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness k. Using Buckingham's π-theorem, obtain expression for Δp. [5+5]

OR

5.a) What are different types of dimensionless numbers and explain them?
b) A ship model of scale 1/50 is towed through sea water at a speed of 1 m/s. A force of 2 N is required to tow the model. Determine the speed of ship and propulsive force on the ship, if the prototype is subjected to wave resistance only. [5+5]

6.a) Show that the force exerted by a jet of water on an inclined fixed plate in the direction of the jet is given by $F_x=\rho\ aV^2\ Sin^2\ \theta$, where a = Area of the jet, V = velocity of the jet and θ = inclination of the plate with the jet.

b) A jet of water having a velocity of 20 m/sec strikes a curved vane which is moving with a velocity of 9 m/sec. The vane is symmetrical and is so shaped that the jet is deflected through 120 degrees. Find the angle of the jet at inlet of the vane if there is no shock. What is the absolute velocity of the jet at outlet in magnitude and direction and the work done per second per unit weight of water strikings. Assume the vane to be smooth. [5+5]

OR

7.a) Prove that the force exerted by a jet of water on a fixed semi-circular plate in the direction of the jet when the jet strikes at the centre of the semi-circular plate is two times the force exerted by the jet on an fixed vertical plane.

b) A jet of water of 10 cm diameter is discharging under a constant head of 80 m. Find the force exerted by the jet on a fixed plate. Take coefficient of velocity as 0.9. [5+5]

8.a) What are the uses of a draft tube? Describe with neat sketches different types of draft tubes.

b) A turbine develops 7355 kW under a head of 24.7 m at 210 rpm. What is its specific speed? Indicate the type of turbine suitable for this purpose. If this turbine is tested in the laboratory where the head of water available is only 7.5 m, what power will it develop at what speed? [5+5]

OR

9.a) Define the term unit power, unit speed and unit discharge with reference to a hydraulic turbine. And also derive the expression for these terms.

b) A turbine develops 9000 kW when running at a speed of 140 rpm and under a head of 30 m. Determine the specific speed of the turbine. [5+5]

10.a) Define cavitation. What are the effects of cavitation? Give the necessary precaution against the cavitation.

b) The diameter of an impeller of a centrifugal pump at inlet and outlet are 300 mm and 600 mm respectively. The velocity of flow at outlet is 2.5 m/sec and vanes are set back at an angle of 45 degrees at outlet. Determine the minimum starting speed of the pump if the manometer efficiency is 75%. [5+5]

OR

11.a) What are the various applications of Hydroelectric power plant.

b) A centrifugal pump rotating at 1000 rpm delivers 160 liters/s of water against a head of 30 m. The pump is installed at a place where atmospheric pressure is 1×10^5 P_a(abs.) and vapour pressure of water is 2 kP_a (abs.). The head loss in suction pipe is equivalent to 0.2 m of water. Calculate minimum NPSH. [5+5]

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