Code: 9A01402

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

HYDRAULICS & HYDRAULIC MACHINERY

(Civil Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions
All questions carry equal marks
*****

1 (a) Give complete classification of the different types of open channel flow.
(b) Water flows uniformly at a depth of 1.2 meters in a rectangular canal 3 metres wide laid at a slope of 1 metre per 1000 metres. What is the mean shear stress on the sides and bottom of the canal? Based on the Reynolds and Froude numbers, determine the type of flow in the canal. Take Chezy C as 70 and kinematic viscosity is10-6 m2/s.

2 (a) Explain the phenomenon of hydraulic jump and the significance of Froude number. Derive the required equations.
(b) Describe in brief, the different types of non-uniform flow profiles.

3 A river discharges 2500 cumecs. The rugosity coefficient of the river bed is 0.028. If a model of the river is made adopting a horizontal scale ratio 1:1000 and a vertical scale ratio 1:75, calculate the discharge in the model and the rugosity coefficient of its bed.

4 A jet of water having a velocity of 40 m/sec strikes a curved vane, which is moving with a velocity of 20 m/sec. The jet makes an angle of 300 with the direction of motion of the vane at inlet and leaves at an angle of 900 to the direction of motion of the vane at outlet. Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet so that the water enters and leaves the vane without shock.

5 A Francis turbine is fitted with a straight conical draft tube of height 6 m and diameters 1 m at top and 2 m at bottom. The draft tube is submerged in the tail race to a height of 1.5 m. The velocity of water at the draft tube inlet is 6 m/s. Assume that the friction head lost in tube is 0.125 times the velocity head at inlet. Compute the efficiency of the draft tube and the vacuum pressure of water at the draft tube inlet. What is the head and power saved by the draft tube?

6 (a) Derive the equation of unit speed and unit discharge of a turbine.
(b) What is cavitation? How can it be avoided in reaction turbine?

7 (a) Discuss the detailed classification of pumps.
(b) What precautions are to be taken while starting and closing the pump?

8 (a) Explain load factor, utilization factor and capacity factor. What is the significance of them?
(b) The average annual yield of a river at a dam site is 2000 ha-m. Assuming that the entire yield is available for power generation, estimate the water power potential. The average net head available is 52 m. Also estimate the available energy. Take efficiency of turbine as 80% and the efficiency of the generator as 90%.

*****

Code: 9A01402

2

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

HYDRAULICS & HYDRAULIC MACHINERY

(Civil Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions
All questions carry equal marks
*****

1 (a) Explain Kinetic energy correction and momentum energy correction factors by giving expressions for them.
(b) A field drain of triangular section has side slopes of 1 upon 2 and carries water at a normal depth of 0.75 m. Chezy's C for the channel is 45. Determine the longitudinal slope of the drain for a discharge of 1.2 cumecs. Determine the Froude number and identify the state of flow. Assume α = 1.16.

2 (a) State the conditions when flow is uniform and when it is non-uniform in channels.
(b) What are the conditions favorable for the formation of a hydraulic jump in an open channel? Draw a neat sketch and explain.

3 (a) The revisiting force F of a supersonic plane during flight can be considered as dependent upon the length of air craft l, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force.
(b) Oil of density 917 kg/m3 and dynamic viscosity 0.29 Pa.s flows in a 15 cm dia. Pipe at a velocity of 2.0 m3/s. What would be the velocity of flow of water in a 1.0 cm diameter pipe, to make the two flows dynamically similar? The density and viscosity of water can be taken as 998 kg/m3 and 1.31×10−3 Pa.s respectively.

4 A jet of water having a velocity of 20 m/s strikes on a series of vanes moving with a velocity of 8 m/s. The jet makes an angle of 300 with the direction of motion of vanes when entering and leaves at an angle of 1500 with the direction of motion. Sketch the velocity triangles and calculate: (i) An angle at inlet and outlet.
(ii) Work done when the vane is discharging 300 liters/second.

5 (a) Draw a neat diagram of Kaplan turbine and explain its working. State important equations.
(b) Explain in detail, how you find the efficiency of draft tube.

6 (a) Distinguish between specific speed and unit speed of a turbine.
(b) Show that Pelton turbine is a low specific speed turbine.

7s (a) Discuss the concept of multistage pumps in detail.
(b) A centrifugal pump has three stages discharging 120 lit/s, working against a head of 45 m, running at 1400 rpm. Calculate the specific speed of the pump.

8 (a) What are power canals? How these are different from irrigations canals?
(b) Write short notes on: (i) Scroll casing (ii) Draft-tube and (iii) Tailrace.

*****

Code: 9A01402 3

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012
HYDRAULICS & HYDRAULIC MACHINERY
(Civil Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions
All questions carry equal marks
*****

1 (a) Prove that for a channel of circular section the depth of flow d = 0.95 D for maximum discharge where d = depth of flow and D = diameter of circular channel.
(b) The cross-section of an open channel consists of semi-circular bottom 1.20 m in diameter and with vertical sides. If the depth of water is 1.20 m and the bed slope is 1 in 2500, calculate the discharge. Take Chezy's C as 65.

2 (a) Differentiate between G.V.F. and R.V.F. by giving practical examples for both.
(b) A sluice gate discharges water into a horizontal rectangular channel with a velocity of 10 m/sec and a depth of flow of 1 m. Determine the depth of flow after the hydraulic jump and the consequent loss in total head.

3 Assuming that the viscous force F exerted by a fluid on a sphere of diameter D depends on the viscosity μ , mass density of the fluid "ρ " and the velocity of the sphere u, obtain and expression for the viscous force.

4 (a) Draw and explain velocity triangles at inlet and outlet for different cases in which a jet of water striking the flat and curved vanes.
(b) A jet of water, having a velocity of 30 m/s impinges on a series of vanes with a velocity of 15 m/s. The jet makes an angle of 300 to the direction of motion of vanes when entering and leaves at an angle of 1200. Sketch velocity triangles at entrance and exit, and determine the vane angles, so that the water enters and leaves without shock.

5 (a) Write a detailed note on different efficiencies of a turbine.
(b) Explain, on what basis, the turbines are classified.

6 (a) Where is servo meter used in governing mechanism of turbines? Explain it in detail.
(b) How do you compare the performance of a turbine under different working conditions?

7 (a) Why is priming necessary for centrifugal pumps? What are the various methods of priming a centrifugal pump?
(b) A centrifugal pump delivers 10 litres of water per second under a head of 20 m. The speed of the shaft is 1200 rpm. Find its specific speed.

8 (a) What are anchor blocks? Where and why these are provided?
(b) What is a surge tank? Discuss its function and working.

*****

Code: 9A01402

4

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

HYDRAULICS & HYDRAULIC MACHINERY

(Civil Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions
All questions carry equal marks
*****

1 (a) Derive an expression for the discharge through a channel by Chezy's formula.
(b) Determine the dimensions of the most economical trapezoidal earth lined channel (Manning's n= 0.020) to carry 14 m3/s at a slope of 4 in 10,000.

2 (a) What are "Alternate" depths? What are "Conjugate" depths? Can a sequent depth be called a conjugate depth.
(b) The initial and sequent depths of a hydraulic jump in a horizontal rectangular channel are 0.6 m and 3.6 m respectively. What is the initial Froude number? What is the energy loss?

3 (a) For models governed by viscous forces, obtain the scaling ratios for velocity, discharge, energy and power.
(b) The time period T of water surface waves is known to depend on the wave length λ, depth of flow D, density of the fluid ρ, acceleration due to gravity g and surface tension σ. Obtain the dimensionless form of the functional relationship.

4 (a) Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet.
(b) A jet of water of diameter 50 mm moving with a velocity of 20 m/s strikes a fixed plate in such a way that the angle between the jet and the plate is 60°. Find the force exerted by a jet on the plate (i) in the direction normal to the plate and (ii) in the direction of the jet.

5 A Kaplan turbine develops 60,000 kw of power under a head of 25 m with overall efficiency of 90%. Taking the value of flow ratio = 0.5, speed ratio = 1.6, the hub diameter as 0.35 times the diameter of the runner, find: (i) The diameter of the runner.
(ii) The speed of the turbine. (iii) The specific speed of the turbine.

6 (a) Tests were conducted on a Francis turbine of 0.8m diameter under a head of 9 m. The turbine developed 115 KW running at 240 rpm and consuming 1.2 m3/sec. If the same turbine is operated under a head of 16m, predict its new speed, discharge and power.
(b) What do you mean by cavitation? What are the physical indicators for the presence of cavitation in turbines?

7 (a) Draw a typical layout and explain the working of centrifugal pump. Also indicate various components.
(b) Explain the method of selection of centrifugal pumps with the aid of characteristic curves.

8 (a) Describe different structures associated with the intake to penstock. Discuss their uses.
(b) Write short notes on (i) Forebay (ii) Intake structure (iii) Penstock.

*****