Code No: R22014 **R10** SET - 1

II B. Tech II Semester, Supplementary Examinations, Dec – 2012
HYDRAULICS AND HYDRAULIC MACHINERY
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Derive expression for kinetic energy correction factor.
   b) Velocity distribution in an open rectangular channel is given by $V=3y^{1/2}$. If the width of the channel is 10 m and the depth of flow is 1 m , find the average velocity of the cross section, energy correction factor and momentum correction factor.

2. 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 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?

3. a) State the Buckingham's π –theorem. What do you mean by repeating variables? How are the repeating variables selected in dimensional analysis?
   b) A pipe of diameter 1.5 m is required to transport an oil of specific gravity 0.90 and viscosity $3x10^{-2}$ poise at the rate of 3000 liter/s. Test were conducted on a 15 cm diameter pipe using water at 20^{o} C. Find the velocity and rate of flow in the model. Viscosity of water at 20^{o} C=0.01 poise.

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) Find the force exerted by a jet of water of diameter 100 mm on a stationary flat plate, when the jet strikes the plate normally with velocity of 30 m/s.

5. a) Explain the classification of hydraulic turbines.
   b) A Kaplan turbine produces 60,000 kW under a net head of 25 m with an overall efficiency of 90%. Taking the value of speed ration as 1.6 and flow ratio as 0.5 and hub diameter as 0.35 times the outer diameter , find the diameter and speed of the turbine.

6. a) Define specific speed and derive the expressions for specific speed.
   b) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 cumec. If the efficiency is 90%, determine specific speed of the turbine, power generation and type of turbine.

7. a) Define centrifugal pump and explain the working of a single-stage centrifugal pump with neat sketch.
   b) A centrifugal pump is to discharge 0.118 m^3/s at a speed of 1450 rpm against head of 25 m. the impeller diameter is 250 mm, its width at outlet is 50 mm and manometer efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.

8. a) Explain detailed estimations of hydropower plant
   b) What are various classifications of hydropower plant?
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Code No: R22014 **R10** SET - 2

II B. Tech II Semester, Supplementary Examinations, Dec – 2012
HYDRAULICS AND HYDRAULIC MACHINERY
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Time: 3 hours Max. Marks: 75

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1. a) State the factors affecting Manning's *n* and explain their effect on Manning's *n.*
   b) A trapezoidal channel had a bed width of 3 m and side slope *of 1.5* (H) :1 (V). Calculate the normal depth corresponding to discharge of 15 m^3/s. The bed slope of the channel is 0.0009 and n=0.015.

2. a) A rectangular channel carries a discharge of 3 m^3/s per m width. If the loss of energy in the hydraulic jump is found to be 3.2 m, determine the conjugate depths before and after the jump.
   b) Distinguish between (i) Positive and negative surges; (ii) rejection and demand surges
   c) Write short notes on momentum equation in open channel flow.

3. a) Explain about different types of forces acting in moving fluid.
   b) The pressure difference Δp in a pipe of diameter D and length,L 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.

4. 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. 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?

6. 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.

7. a) What is the difference between single-stage and multistage pumps? Describe multistage pump with (i) impeller in parallel (ii) impeller in series.
   b) The diameter of an impeller of a centrifugal pump at inlet and outlet are 20 cm and 40 cm respectively. Determine the minimum speed for starting the pump if it works against a head of 25 m.

8. a) Explain various advantages and disadvantages of hydroelectric power plant.
   b) Define the terms (i) Utilization factor (ii) Capacity factor.
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Code No: R22014 **R10** SET - 3

II B. Tech II Semester, Supplementary Examinations, Dec – 2012
HYDRAULICS AND HYDRAULIC MACHINERY
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. a) Explain the terms alternative depths and conjugate depths.
   b) If Fr_1 and Fr_2 are the Froude numbers corresponding to alternate depths y_1 and y_2 at certain discharge through a rectangular channel, show that $Y_1/y_2 = (Fr_2/Fr_1)^{1/2} = 2+Fr_2^{\ 2}/\ 2+Fr_1^{\ 2}$

2. a) What is a control section? Describe with sketches any two control sections?
   b) Give sketches with examples for the following types of GVF profiles in an open channel: H3, M2,S2,S3,C1.
   c) A wide rectangular channel carries a discharge intensity of 4 m^3/s per meter width. The longitudinal slope of the channel is 0.00005. Calculate the GVF profile produced by a sudden drop in the bed of the channel. Assume manning's n =0.03.

3. 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.

4. a) Show that the efficiency of a free jet striking normally on a series of flat plates mounted on the periphery of a wheel can never exceed 50%.
   b) A jet of water of diameter 100 mm strikes a curved plate at its centre with a velocity of 15 m/s. The curved plate is moving with a velocity of 7 m/s in the direction of the jet. The jet is deflected through an angle of 150^o . Assuming the plate smooth find (i) forced exerted on the plate in the direction of the jet (ii) power of the jet (iii) efficiency.

5. a) Design a pelton wheel which is required to develop 1500 kW, when working under a head of 160 m at a speed of 420 rpm. The overall efficiency may be taken as 85% and assume other data required.
   b) Explain the principle on which Kaplan turbine works with a neat sketch.

6. a) What is cavitation? How can it be avoided in reaction turbine.
   b) A turbine develops 9000 kW when running at 10 rpm. The head on the turbine is 30 m. If the head on the turbine is reduced to 18m, determine the speed and power developed by the turbine.

7. 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/s and vane are set back at an angle of 45 degrees at outlet. Determine the minimum starting speed of the pump in the manometer efficiency is 75%.

8. a) Explain different classifications of hydropower plant.
   b) Define the terms (i) Load factor (ii)utilization factor
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Code No: R22014 **R10** SET - 4

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1. a) What is critical depth? With usual notations prove that in case of a rectangular channel $y_c=(q^2/g)^{1/3}$
   b) A 10 m wide rectangular channel carries a discharge of 20 m^3/s with a depth of 2m. Find the width to which the channel should be contracted to get critical flow at the contracted section.

2. a) Write a note on the characteristics of the jump in the horizontal rectangular channel.
   b) Calculate the amount of energy dissipated by hydraulic jump, if Froude number before jump is 4.0 and $y_1/y_2=1/4$, when the discharge of the channel is 225 lps per meter width.

3. a) Write short notes on model and prototype.
   b) In a 1 in 20 model of stilling basin, the height of the hydraulic jump in the model is observed to be 0.20 meter. What is the height of the hydraulic jump in the prototype? if the energy dissipated in the model is 1/10 kW, What is the corresponding value in prototype?

4. 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/s strikes a curved vane which is moving with a velocity of 9 m/s. 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 is that 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. a) A Francise turbine runner having a diameter of 2.92 m. operates at 163.5 rpm, under 54 m head, and develops 19900 kW at an efficiency of 87%. Find the other characteristics if this turbine is operated under 60 m head.
   b) What are the characteristics curves of a hydraulic turbine? How are they useful to practical engineer?

6. a) What do you understand by the characteristics curves of a turbine? Name the important type of characteristic curve.
   b) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 cumec. If the efficiency is 90%, determine the performance of the turbine under a head of 20 metre.

7. a) with a neat sketch, explain the principle and working of a centrifugal pump.
   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 $1x10^5$ P_a(abs.) and vapour pressure of water is 2 kP_a (abs.). The head loss is suction pipe is equivalent to 0.2 m of water. Calculate minimum NPSH

8. a) Discuss detail estimation of hydropower plant.
   b) What are the various applications of Hydroelectric power plant.
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