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

II B. Tech II Semester Regular Examinations April/May – 2013
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) Explain specific energy concept with the curve and derive equations for critical depth and critical velocity.
   b) A rectangular channel 5.5 m wide and 1.25 m depth has a slope of 1 in 900. Determine the discharge when manning's N = 0.015. If it is desired to increase the discharge to a maximum by changing the size of the channel but keeping the same quantity of lining, Determine the new dimensions and percentage increase in discharge.

2. a) Explain G.V.F.? derive an expression to solve the basic differential equation of G.V.F.
   b) A wide rectangular channel 8m wide is to be laid at a slope of 1/64 and carries a discharge of 40 m^3/sec. A barrier across the channel raises the water surface of 3m just upstream of the barrier. Find the length of the surface profile up to the hydraulic jump upstream. Assume manning's coefficient as 0.025.

3. a) Velocity of sound in air varies as bulk modulus 'K', Mass density 'ρ'. Derive an expression for velocity.
   b) A pipe of diameter 15 mm is required to transmit an oil of specific gravity 0.9 and viscosity 3 x 10^{-2} poise at 3000 lps. Tests were conducted on 150 mm diameter pipe using water at 20^0. Find velocity and flow rate of flow of model if 'μ' of water at 20^0, is 0.01 poise.

4. a) Derive the equation of force exerted by a jet on an unsymmetrical curved vane tangentially, the jet and vane moving in x axis direction but are no collinear. Draw the velocity triangles and explain. Also find the work done and efficiency.
   b) A jet of water having a velocity of 35 m/sec strikes a series of radial curved vanes mounted on a wheel. The wheel has 200 rpm. The jet makes 20^0 with the tangent to wheel at inlet and leaves the wheel with a velocity of 5 m/sec at 130^0 to the tangent at outlet. The diameters of wheel are 1m and 0.5m. Find
   i) Vane angles at inlet and outlet ii) Work done iii) Efficiency of the system.
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5. a) Draw a neat sketch of a layout of hydroelectric plant and explain terms including various heads and efficiency.
   b) An Inward flow reaction turbine has external and internal diameters as 1m and 0.6m respectively. The hydraulic efficiency of the turbine is 90% when head on the turbine is36m. The velocity of flow at outlet is 2.5 m/sec and discharge at outlet is radial. The vane angle at outlet is 15^0 and width of wheel is 10 cm at inlet and outlet. Determine:
   i) The guide blade angle
   ii) Speed of the turbine
   iii) Vane angle of the runner at inlet
   iv) Volume flow rate of turbine
   v) Power developed.

6. a) Draw neat sketch of governor of a turbine and explain its functioning.
   b) Derive the equation for specific speed of a turbine.

7. a) Draw neat sketch of a centrifugal pump and explain the parts.
   b) A centrifugal pump lifts water against a head of 40 m .The suction and delivery pipes are each 150 mm in diameter. The head losses in the suction and delivery pipes are respectively 2.2 m and 7.5 m. The impeller is 400 mm in diameter and 25 mm wide at mouth. It revolves at 1200 rpm and the vane angle at exit is 30^0. If the manometric efficiency is 85%. Calculate the discharge.

8. a) Explain the advantages, which make Hydropower is more attractive.
   b) A runoff stream with an installed capacity of 12000 KW operates at 15% load factor when it serves as a peak load station. What should be the lowest discharge in the stream so that the station may serve as the base load station. It is given that plant efficiency is 70% when working under a head of 18m.Also calculate maximum load factor of the plant when the discharge in the stream rises to 15 m^3/sec.

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Code No: R22014 **R10** SET - 2

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(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. a) Derive the conditions for the most economical trapezoidal channel section.
   b) A canal is to have a trapezoidal section with one side vertical and the other sloping at 45^0. It has to carry 30 m^3 of water per second with mean velocity of 2 m/sec. Computed the dimensions of the section which will require the minimum lining.

2. a) A horizontal rectangular channel 4m wide carries a discharge of 16 m^3/sec. Determine whether a jump may occur at an initial depth of 0.5 m or not. If a jump occurs, determine the sequent depth. Also determine the energy loss in the jump.
   b) List the assumptions made in the derivation of dynamic of gradually varied flow.

3. a) What do you mean by repeating varibles. How are the repeating varibles selected for dimension analysis.
   b) A 7.2 meters high and 15 m long spilway discharges 90 m^3/sec of water under a head of 2.0 meters. If a 1:9 scale model of this spillway is to be constructed, Determine model dimensions, head over the spillway model and the model charge. If a model experiences a force of 7500 N, Determine force on the prototype.

4. a) A nozzle of 56 mm diameter delivers a stream of water at 30 m/sec perpendicular to a plate that moves away from the jet at 8 m/sec. Find the work done and efficiency of the jet.
   b) Prove that the force exerted by a jet of water on a fixed curved vane when the jet strikes at the centre is $F = \rho a v^2 (1+\cos\theta)$ where
      ρ = Mass density of water
      a = Area of cross section of the jet
      v = Velocity of the jet
      θ = Angle of the curved plate at the out let.
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5. a) Discuss the application of collapse of bubble theory to hydraulic machines.
   b) A Kaplan turbine working under a head of 25 m develops 16000 kW shaft power. The outer diameter of the runner is 4 m and hub diameter is 2 m. The guide blade angle is 35^0. The hydraulic and overall efficiency are 90% and 85% respectively. If the velocity of whirl is zero at outlet, determine the runner vane angles at inlet and outlet, and speed of turbine.

6. a) Explain the effect of cavitation on the performance of water turbines.
   b) List out different types of surge tanks and explain any two with neat sketches.

7. a) What do you understand by characteristic curves of a pump? What is the significance of the Characteristic curves? Explain them in detail.
   b) The diameter of a centrifugal pump, which is discharging 0.035 m^3/s of water against a total head of 25 m is 0.05m. The pump is running at 1200 rpm. Find the head, discharge and ratio of powers of a geometrically similar pump of diameter 0.3m when it is running at 2000 rpm.

8. a) A Run-off river plant operates as a peak load station with weekly load factor of 30%. What will be minimum flow in the river so that the station may act as base load station? Assume: Rated installed capacity of generator = 15,000 KW: operating head = 25m plant efficiency = 75% Also determine the daily load factor if the river flow is 20 m^3/sec.
   b) What is load duration curve? Explain its significance and applications with neat graph.

Code No: R22014 **R10** SET - 3

II B. Tech II Semester Regular Examinations April/May – 2013
HYDRAULICS AND HYDRAULIC MACHINERY
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. a) Define conveyance of a channel. Find the discharge in a trapezoidal channel with a bed width of 10 m, side slopes 1:1 and depth of flow of 2.0 m under uniform flow condition. Bed slope is $1x10^{-4}$ and mannings roughness coefficient = 0.025. Also find chezy's coefficient at this depth.
   b) Derive the relationship between flow depth ' y' and radius 'r' in a circular channel, for
   i) Maximum Discharge ii) Maximum velocity.

2. a) Show that slope of free surface profile can be expressed by

$$\frac{dy}{dx} = \frac{s_0\left[1-\left(y_n/y\right)^3\right]}{\left[1-\left(y_c/y\right)^3\right]}$$

   b) Hydraulic jump is sometimes used as energy dissipater at the toe of the spillway of a dam, why. Discuss different ways for obtaining the hydraulic jump. Prove that relative height of the jump depend only on flow corresponding supercritical condition's Froude number.

3. a) Briefly explain the principle of similitude.
   b) State Buckingham's pi theorem and explain their importance in dimensional analysis.
   c) Explain in detail about Distorted and undistorted models.

4. a) Show that the efficiency of a free jet striking normally on a series of vanes mounted on the periphery of a wheel exceed 50%.
   b) A jet of water of 30 mm diameter, moving with a velocity of 15 m/sec, strikes a hinged square plate of weight 245.25 N at the centre of the plate. The plate is of uniform thickness. Find the angle through which the plate will swing.
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5. a) Define a draft tube. What are the uses of a draft tube. Describe any two different types draft tubes with neat sketches.
   b) A pelton wheel is to be designed for the following specifications:
   Shaft power = 11,772 KW; Head = 380 m; Speed = 750 rpm; Overall efficiency= 86%; jet diameter is not to exceed one - sixth of the wheel diameter. Determine:
   i) The Wheel diameter
   ii) The no. of jets required
   iii) Diameter of the jet
   Take K_v= 0.985 and K_u= 0.45.

6. a) What are unit quantities? Define the unit quantities for a turbine. Why are they important?
   b) Explain the significance of surge tank and state its advantages.Explain any one.

7. a) Derive the expression for the minimum speed for starting a centrifugal pump.
   b) Describe axial and mixed flow pumps. Sketch different characteristics curves for centrifugal pump. How these curves can used in selecting a pump.

8. a) What is the pumped storage plant? What are its advantages and limitations?
   b) The run-off river hydropower plant has inflow of 30 m^3/sec and its works on head of 50m with a provision for pondage to meet daily demand with load factor of 75%. Determine the power generation capacity of plant at 85% overall efficiency. What amount of podage needed if the plant operates at the peak station for six hours.

Code No: R22014 **R10** SET - 4

II B. Tech II Semester Regular Examinations April/May – 2013
HYDRAULICS AND HYDRAULIC MACHINERY
(Civil Engineering)

Time: 3 hours Max. Marks: 75

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1. a) Difference between traquil and critical flow. Show that for a given specific energy, the discharge in maximum when Q^2T/gA^3 =1.0. Where symbols have their usual meanings.
   b) A rectangular channel has sides 2.50 m high and conveys water at a depth of 1.6 m at a velocity of 1.9 m/s. The channel is 1200 m long. If the flow is suddenly stopped by closing a gate at the downstream end of the channel, determine whether the water will spill over the side as a consequence of surge produced. Find also the interval of time required for the surge to reach the upstream end of the channel.

2. a) Explain the G.V.F profiles produced on Steep slope and critical slope with neat sketch.
   b) A rectangular channel is 5m wide and carries a discharge of 20 m^3/sec at a depth of 2m. At a certain section it is proposed to build a jump. Calculate the water surface elevations at upstream of the jump and over the jump. If the jump height is i) 2m ii) 1.5m. Neglect energy losses in the transition.

3. a) What is the significance of dimensionless number? Name any four.
   b) The pressure difference 'ΔP' in a pipe of diameter 'D' and length 'L' due to viscous flow depends on the velocity 'V', Viscosity 'μ' and density 'ρ'. Using Buckingham's pi theroem, obtain an expression for ΔP.

4. a) Find an expression for the efficiency of a series of moving curved vanes when a jet of water strikes the vanes at one of its tips.
   b) A jet of water of diameter 65 mm moving with a velocity of 30 m/sec, strikes a curved fixed plate tangentially at one end at angle of 30^0 to the horizontal. The jet leaves the plate at an angle of 18^0 to the horizontal. Find the force exerted by the jet on the plate in horizontal and vertical directions.

5. a) Determine the output power, Speed, Specific speed and vane angle at exit of a Francis runner using the following data: Head = 75 m, Hydraulic efficiency = 92%, Overall efficiency = 86%, Runner diameters = 1m and 0.5 m, Width = 150 mm and guide blade angle = 18^0. Assume that the runner vanes are set normal to periphery at inlet.
   b) Write a neat sketch of a Kaplan turbine, Explain the parts and functioning of the turbine. Write the equation involved to solve problem.
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6. a) Define the specific speed of a turbine. Derive an expression for the specific speed. Classify the turbines based on specific speed.
   b) What is cavitation. how it can be avoided in reaction turbines.If cavitation were to occurs,at what locations the cavitation damage is likely to take place.

7. a)Explain the working of centrifugal pump with neat sketch?
   b) Find the rise in pressure in the impeller of a centrifugal pump through which water is owing at tthe rate of 0.01 m^3. The internal and external diamter of the impeller are 15 cm and 30 cm respectively. The widths of the impeller at inlet and outlet are 1.2 cm and 0.6cm. The pump is running at 1500 rpm. The water enters the impeller radially at inlet and impeller vane angle at outlet is 45^0. Neglect losses through the impeller.

8. a) State the different types of run- off river plants. Explain the components and their functions of run-off river plant.
   b) Explain hydropower of india on the basis of river systems, number of schemes and percentage potential developed.