Code No: R1622013 **R16** SET - 1

II B. Tech II Semester Regular Examinations, April - 2018
HYDRAULICS AND HYDRAULIC MACHINERY
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) What is the purpose of providing bed slope in open channels (2M)
   b) What is a specific energy curve? (2M)
   c) What are limitations of hydraulic similitude (3M)
   d) List out the applications of impact of free jets (3M)
   e) Define the hydraulic efficiency and mechanical efficiency of the turbine (2M)
   f) Define the Mechanical efficiency and Overall efficiency of the centrifugal pump? (2M)

PART –B

2. A canal of trapezoidal section has bed width of 7 m and bed slope of 1 in 3500 .If the depth of flow is 2.7 m and side slopes of the channel are 1 horizontal to 3 vertical, determine the average flow velocity and the discharge carried by the channel. Also compute the average shear stress at the channel boundary. Take value of Chezy's constant = 50 (14M)

3. A wide channel laid to a slope of 1 in 900 carries a discharge of 3 m^3/s per meter width at a depth of 1.8 m. Find out the value of Chezy's constant C. Consider the flow to be uniform. If the actual depth varies from 1.5 m at an upstream location to 1.7 m at a location 300 m downstream or in other words the flow is gradually varied, what will be the value of Chezy's coefficient C (14M)

4. A 120 m long surface vessel is to be tested by a 3 m long model. If the vessel travels at 10 m/s, at what speed must model be towed for dynamic similarity between the model and prototype? If the drag of the model is 9.37 N, What prototype drag is to be expected? (14M)

5. a) Show that the force exerted by a jet of water on moving inclined plate in the direction of jet is given by (7M)
   $F_x = \rho a(V-u)^2 \sin^2\theta$
   b) A 75 mm diameter jet having a velocity of 30m/s strikes a flat plate, the normal of which is inclined at 45^0 to the axis of the jet. Find the normal pressure on the plate when it is moving with a velocity of 15 m/s in the direction of the jet, away from the jet. Also determine the power and efficiency of the jet when the plate is moving. (7M)
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6. a) Explain the working of draft tube with neat sketch and how do the losses in the draft tube effect the pressure at runner exit? (7M)
   b) Draw the characteristic curves for the Francis turbines and also explain the working of Francis turbine with neat sketch. (7M)

7. a) Enumerate the losses which occur when a centrifugal pump operates (7M)
   b) Define the specific speed of the turbine and also derive the expression for the specific speed of the centrifugal pump (7M)

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PART –A

1. a) What is Bazin's formula and how is it used (2M)
   b) What do you understand by critical depth of an open channel when the flow is not uniform (3M)
   c) How are hydraulic models classified? (2M)
   d) Explain the basic principle involved in the impact of free jets (2M)
   e) Define the volumetric efficiency and overall efficiency of the turbine (2M)
   f) Define the following the terms (i) Static head (ii) Manometric head (iii) Total head. (3M)

PART –B

2. A rectangular channel 5 m wide has depth of water 2 m. The slope of the bed of the channel is 1 in 900 and value of chezy's constant C=50.It is desired to increase the discharge to a maximum by changing the dimensions of the section for constant area of cross-section, slope of the bed and roughness of the channel. Find the new dimensions of the channel and increase in discharge (14M)

3. The normal depth of flow of water, in a rectangular channel 1.5 m wide, is one meter. The bed slope of the channel is 0.0006 and Manning's rugosity coefficient N 0.012.Find the critical depth.
   At a certain section of the same channel the depth is 0.92 m while at a second section the depth is 0.86 m. Find the distance between the two sections. Also, find whether the section is located downstream or upstream with respect to the first section (14M)

4. In 1:30 model of a spill way, the velocity and discharge are 1.5 m/s and 2 m/s. Find the corresponding velocity and discharge in the prototype (14M)

5. a) Derive an expression for the force exerted by a jet of water on stationary inclined plate in the direction of jet. (7M)
   b) A jet of water from a nozzle is deflected through 60^0 from its original direction by curved plate which it enters tangentially without the shock with a velocity of 30 m/s and leaves with a mean velocity of 25 m/s. If the discharge from the nozzle is 0.8 kg/s, Calculate the magnitude and direction of the resultant force on the vane, if the vane is stationary (7M)
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Code No: R1622013 **R16** SET - 2

6. a) Sketch and describe a modern method of regulation to maintain a constant speed for the pelton wheel (7M)
   b) Draw the characteristic curves for the pelton wheel and explain the importance of characteristic curves (7M)

7. a) Why are centrifugal pumps used sometimes in series and sometimes in parallel/ What is the effect of number of vanes of impeller on head and efficiency? (7M)
   b) Discuss the influence of exit blade angle on the performance and efficiency of a centrifugal pump. Assume radial flow at entrance (7M)

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PART –A

1. a) What is meant by Prismatic channel? How it is classified (3M)
   b) What is meant by Rapidly varied flow? In which cases the rapidly varied flow takes place? (3M)
   c) What are the advantages of model testing (2M)
   d) Write an expression for the force exerted by the jet on the stationary plate in the direction of jet (2M)
      (i) When flat plate is held normal to the jet
      (ii) When the flat plate is held inclined to the jet
   e) Why the draft tube is necessary installed in the reaction turbines? (2M)
   f) What do you mean by Net Positive Suction Head (2M)

PART –B

2. A trapezoidal channel having the side slope equal to 60^0 with the horizontal and laid on a slope of 1 in 750,carries a discharge of 10 m^3/s. Find the width at the base and depth of flow for most economical section. Take the value of Cheyzy's resistance coefficient C= 60 (14M)

3. Calculate the specific energy of 12 m^3/s of water flowing with a velocity of 1.5 m/s in a rectangular channel 7.5 m wide. Find the depth of water in the channel when the specific energy would be minimum. What would be the value of critical velocity as well as minimum specific energy? (14M)

4. An air duct is to be modeled to a scale odf1:20 and tested with water which is 50 times viscous and 800 times denser than air. When tested under dynamically similar conditions, the pressure drop between the two sections in the model is 235kPa.What is the corresponding pressure drop in the prototype? (14M)

5. A 30 mm diameter jet strikes without shock on a series of vanes. The jet velocity is 60 m/s and the vanes move in the same direction as the jet. The shape of each vane is such that, when stationary, it would deflect the jet through an angle of 150^0.The friction reduces the relative velocity by 10% as water flows across the vanes and there is a further windage loss is given by $u^2/2$ Nm/kg of water, where u is the vane speed. Determine: (14M)
   (i) The velocity of vanes corresponding to maximum efficiency, and
   (ii) The corresponding thrust on the vanes in the direction of motion
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6. a) With the help of neat sketch explain the construction and working of a pelton wheel turbine (7M)
   b) What is governing? Explain the governing of reaction turbines with neat sketch (7M)

7. A multistage centrifugal pump has four identical impellers, keyed to the same shaft. The width and diameter of each impeller at outlet are 50 mm and 600 mm respectively. The vanes of each impeller are having outlet angle as 45^0.The speed of the pump is 400 rpm and the total manometric head developed is 40 m. If the discharge through the pump is 0.2 m^3/s. find the manometric efficiency (14M)

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PART –A

1. a) Differentiate between the Uniform and Non-Uniform flow (3M)
   b) What is meant by gradually varied flow? In which cases the gradual varied flow takes place? (2M)
   c) What is model analysis and dimensional homogeneity? (2M)
   d) Write an expression for the force exerted by the jet on the moving plate in the direction of jet (2M)
      (i) When flat plate is held normal to the jet
      (ii) When the flat plate is held inclined to the jet
   e) Explain the reason for occurrence of cavitation in the reaction turbines (2M)
   f) List out the different losses in the centrifugal pumps (3M)

PART –B

2. An open channel of most economical section, having the form of a half hexagon with horizontal bottom is required to give a maximum discharge of 20.7 m^3/s of water. The slope of the channel bottom is 1 in 3000.Taking Chezy's constant=50 in Chezy's equation, determine the dimensions of the cross section. (14M)

3. Water flows at a velocity of 1 m/s and a depth of 2m in an open channel of rectangular cross section, 3 m wide. At a certain section the width is reduced to 1.8 m and the bed is raised by 0.65 m. Will the upstream depth be affected? If so, to what extent? (14M)

4. In an aeroplane model of size 1/50 of its prototype the pressure drop is 4 bar. The model is tested in water. Find the corresponding pressure drop in the prototype. Take specific height of air=0.0124 kN/m^2.The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise (14M)

5. The rotor of inward flow hydraulic turbine has a diameter over the tips of the moving vanes of 1.2 m. The diameter at the bottom of the vanes is 0.72 m. The speed is 300 rpm. The water is supplied through fixed vanes at 10^0 to the tangent to the outer circumference of the rotor, the velocity of water being 12 m/s. If the water leaves the moving vanes with the velocity entirely radial and equal to 4.2 m/s, determine: (14M)
   (i) The blade angles at entry and exit, so that the water may enter and leave the moving blades without shock
   (ii) The velocity of water relative to the vanes at the exit
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6. Derive an expression for maximum hydraulic efficiency of a Pelton wheel (14M)

7. a) Explain the working of double acting reciprocating pump with neat sketch (7M)

b) A double-acting reciprocating pump, running at 40 rpm is discharging 1 m^3 of water per minute. The pump has a stroke of 400 mm. The diameter of the piston is 200 mm. The delivery and suction head are 20 m and 5 m respectively. Find the slip of the pump and pump required to drive the pump. (7M)