Code No: RT22012 **R13** SET - 1

II B. Tech II Semester Regular/Supplementary Examinations, April/May-2017
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 **THREE** Questions from **Part-B**

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PART-A

1. a) Find the velocity of flow and rate of flow of water through a rectangular channel of 5 m wide and 2 m deep, when it is running full. The channel is having bed slope of 1 in 3000. Take Chezy's constant C = 50
   b) What do you mean by fundamental units?. Give examples.
   c) Define the term Impacts of jets
   d) Define the term Hydraulic machines
   e) Define the terms suction head and delivery head.
   f) Explain the Plant factor.

PART-B

2. a) Define the term most economical section of a channel. What are the conditions for the rectangular channel to be the best section?
   b) What is meant by an economical section of a channel?

3. a) What is meant by geometric, kinematic and dynamic similarities? Are these similarities truly attainable? If not why?
   b) Define the following non-dimensional numbers: Reynold's number, Froude's number and Mach's number. What are their significances for fluid flow problems?
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Code No: RT22012 **R13** SET - 1

4. a) A jet of water of diameter 150 mm strikes a flat plate normally with a velocity of 12 m/s. The plate is moving with a velocity of 6 m/s in the direction of the jet and away from the jet. Find: (i) The force exerted by the jet on the plate, (ii) Work done by the jet on the plate per second, (iii) power of the jet, and (iv) efficiency of 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°. Find the angle of the jet at inlet of the vane so 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 striking? Assume the vane to be smooth.

5. The following data is related to the pelton wheel:

   Head at the base of the nozzle = 110m,
   Diameter of the jet = 7.5 cm,
   Discharge of the nozzle = 200 litres/s,
   Shaft power = 191.295 kW,
   Power observed in mechanical resistance = 3.675 kW.

   Determine: (i) Power lost in the nozzle and, (ii) Power lost due to hydraulic resistance in the runner.

6. a) What do you understand by characteristics curves of a pump? What is the significance of the characteristic curves?

   b) A single acting reciprocating pump running at 30 r.p.m., delivers0.012 m^3/sec of water. The diameter of the piston is 25 cm and stroke length is 50 cm. Determine: (i) The theoretical discharge of the pump, (ii) Co-efficient of discharge and (iii) Slip and percentage slip of the pump.

7. Explain the following: (i) Load factor (ii) Utilization factor (iii) Estimation of hydropower potential.

Code No: RT22012 **R13** SET - 2

II B. Tech II Semester Regular/Supplementary Examinations, April/May-2017
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 **THREE** Questions from **Part-B**

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PART-A

1. a) What do you understand by Flow in open channel?
   b) What do you mean by derived units? Give examples.
   c) Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet
   d) Differentiate between turbines and pumps.
   e) Define the terms static head and manometric head.
   f) What is a penstock.

PART-B

2. a) Prove that for the trapezoidal channel of most economical section:
   Half of top width = Length of one of the sloping sides.
   Hydraulic mean depth = ½ depth of flow.
   b) Explain how the hydraulic jump forms.

3. a) What is meant by geometric, kinematic and dynamic similarities? Are these similarities truly attainable?
   b) Define the following non-dimensional numbers: Reynold's number, Froude's number and Mach's number. What are their significances for fluid flow problems?
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Code No: RT22012 **R13** SET - 2

4. a) A jet of water of diameter 150 mm strikes a flat plate normally with a velocity of 12 m/s. The plate is moving with a velocity of 6 m/s in the direction of the jet and away from the jet. Find: (i) The force exerted by the jet on the plate, (ii) Work done by the jet on the plate per second, (iii) power of the jet, and (iv) efficiency of 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°. Find the angle of the jet at inlet of the vane so 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. The following data is related to the pelton wheel:

   i) Head at the base of the nozzle = 110m,
   ii) Diameter of the jet = 7.5 cm,
   iii) Discharge of the nozzle = 200 litres/s,
   iv) Shaft power = 191.295 kW,
   v) Power observed in mechanical resistance = 3.675 kW.

   Determine: (i) Power lost in the nozzle and, (ii) Power lost due to hydraulic resistance in the runner.

6. a) Define cavitation, what are the effects of cavitation? Give the necessary precautions against cavitation.

   b) A double acting reciprocating pump, running at 50 r.p.m. is discharging 900 litres of water per minute. The pump has stroke of 400 mm. The diameter of piston is 250 mm. The delivery and suction head are 25 m and 4 m respectively. Find the slip of the pump and power required to drive the pump.

7. Explain the following: (i) Load factor (ii) Utilization factor (iii) Estimation of hydropower potential.

Code No: RT22012 **R13** SET - 3

II B. Tech II Semester Regular/Supplementary Examinations, April/May-2017
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 **THREE** Questions from **Part-B**

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PART-A

1. a) What is rapidly varied flow.
b) Explain the term dimensionally homogeneous equation.
c) Define the term Jet propulsion
d) What do you mean by gross head and efficiency of turbine?
e) How does a centrifugal pump work?
f) Explain surge tank.

PART-B

2. a) Derive the condition for the best side slope of the most economical trapezoidal channel.
b) Find the side slope in a trapezoidal section of maximum efficiency which will carry the same flow as a half square section of the same area.

3. a) What are the different laws on which models are designed for dynamic similarity? Where are they used?
b) Explain the terms: Distorted models and undistorted models. What is the use of distorted models?

4. A jet of water having a velocity of 30 m/s strikes a curved vane, which is moving with a velocity of 15 m/s. The jet makes an angle of 30° with the direction of motion of vane at inlet and leaves at an angle of 120° to the direction of motion of vane at outlet. Calculate: (i) Vane angles, If the water enters and leaves the vane without shock, (ii) Work done per second per unit weight of water striking the vanes per second.

5. An inward flow reaction turbine has an external diameter of 1 m and its breadth at inlet is 200 mm. If the velocity of flow at inlet is 1.5 m/s, find the mass of water passing through the turbine per second. Assume 15% of the area of flow is blocked by blade thickness. If the speed of the runner is 200 r.p.m. and guide blade makes an angle of 15° to the wheel tangent, draw the inlet velocity triangle and find: (i) The runner vane angle at inlet (ii) Velocity of wheel at inlet, (iii) The absolute velocity of water leaving the guide vanes and (iv) The relative velocity of water entering the runner blade.

6. a) How will you determine the possibility of the cavitation to occur in the installation of a turbine or a pump?
b) A single acting reciprocating pump running at 30 r.p.m., delivers 0.012 m^3/sec of water. The diameter of the piston is 25 cm and stroke length is 50 cm. Determine: (i) The theoretical discharge of the pump, (ii) Co-efficient of discharge and (iii) Slip and percentage slip of the pump.

7. Explain the following: (i) Load factor (ii) Utilization factor (iii) Estimation of hydropower potential.
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Code No: RT22012 **R13** SET - 4

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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 **THREE** Questions from **Part-B**

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PART-A

1. a) Explain gradually varied flow.
   b) What do you mean by fundamental units and derived units?
   c) Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet
   d) How will you classify the turbines?
   e) Explain the working of a single – stage centrifugal pump with sketches.
   f) Explain Anchor block.

PART-B

2. a) Prove that for a channel of circular section, the depth of flow, d = 0.81 D for maximum velocity and = 0.95 D for maximum discharge where D = Diameter of circular channel, d = depth of flow.
   b) Explain Specific energy of a flowing liquid, minimum specific energy, critical depth, critical velocity and alternate depths as applied to non-uniform flow.

3. a) What are the different laws on which models are designed for dynamic similarity? Where are they used?
   b) Explain Distorted models and undistorted models. What is the use of distorted models?

4. A jet of water of diameter 50 mm, having a velocity of 30 m/s strikes a curved vane which is moving with a velocity of 15 m/s in the direction of the jet. The jet leaves the vane at an angle of 60° to the direction of motion of vanes at outlet. Determine: (i) The force exerted by the jet on the vane in the direction of motion, (ii) work done per second by the jet.

5. A Francis turbine with an overall efficiency of 70% is required to produce 147.15 kW. It is working under a head of 8 m. The peripheral velocity = 0.30 $\sqrt{2gH}$ and the radial velocity of flow at inlet is 0.96 $\sqrt{2gH}$. The wheel runs at 200 r.p.m. and the hydraulic losses in the turbine are 20% of the available energy. Assume radial discharge, determine: (i) The guide blade angle, (ii) The wheel vane angle at inlet, (iii) Diameter of the wheel at inlet and (iv) width of wheel at inlet.

6. a) Draw and discuss the operating characteristics of a centrifugal pump.
   b) A double acting reciprocating pump, running at 50 r.p.m. is discharging 900 litres of water per minute. The pump has stroke of 400 mm. The diameter of piston is 250 mm. The delivery and suction head are 25 m and 4 m respectively. Find the slip of the pump and power required to drive the pump.

7. Explain the following : i) Estimation of hydropower potential ii) Load factor iii) Utilization factor
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