CODE NO: R09220103

R09

SET No - 1

II B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
HYDRAULICS AND HYDRUALIC MACHINES
(CIVIL ENGINEERING)

Time: 3hours **Max. Marks: 75**

Answer any FIVE questions
All Questions Carry Equal Marks
- - -

1.a) Differentiate between:
i) Uniform and non uniform flow.
ii) Steady and unsteady flow.
iii) Laminar and Turbulent flow.
iv) Sub critical and Super critical flow in a open channel.

b) A rough timber flume (n = 0.012) in the form of an equilateral triangle (apex down) of 1.2 metres sides is laid on slope of 0.01. Calculate the uniform flow rate, which occurs at a depth of 90 cm. [8+7]

2. How will you prove the rate of change of depth along channel depends on bed slope, ratio of the normal depth to the actual depth 'd' and the ratio of the critical depth d_c to the actual depth d. [15]

3. The efficiency η of a fan depends on the density ρ, the dynamic viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. [15]

4. A jet of water having a velocity of 20m/sec strikes a curved vane, which is moving with a velocity of 10m/sec. The jet makes an angle of 20^0 with the direction of motion of vane at inlet and leaves at an angle of 130^0 to the direction of motion of the vane at outlet. Calculate
a) Vane angles, so that the water enters and leaves the vane without shock
b) Work done per second per unit weight of water striking the vane. [15]

5. A Francis turbine having an overall efficiency of 75% is required to give 200 kW under a head of 9 m when running at 120 rpm. The velocity of periphery of the wheel and the velocity of flow at inlet are 3.47 $\sqrt{H}$ and 1.15 $\sqrt{H}$ respectively. If the hydraulic losses in the turbine are 20% of the available energy, find
a) Guide blade angle at inlet
b) Wheel vane angles at the inlet and out let and
c) Diameter of the wheel at inlet and outlet. [15]

6.a) What is kinematic similarity? What is its significance?

b) A turbine develops 1900 KW at 500 rpm under a net head of 22 m. Its diameter is 2.5m. A model of 1:5 is tested under a head of 4 m. Estimate the size, speed, discharge and power developed by the model. Assume an efficiency of 82%. [7+8]

7.a) Differentiate between the volute casing and vortex casing for the centrifugal pump.

b) Write short notes on NPSH in centrifugal pumps.

c) A multistage centrifugal pump is required to lift 1820 litres of water per minute. From a mine, the total head including friction being 672 m. If the speed of the pump is 2920 rpm, how many stages are required? N_S for impeller = 600. [5+5+5]

8. Write short notes on:
   a) Run-of river plants
   b) Valley dam plants
   c) Diversion canal plants
   d) High head diversion plants. [15]

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SET No - 2

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Time: 3hours **Max. Marks: 75**

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. [7+8]

2.a) Define the specific energy. Sketch the specific energy curve and explain regimes of flow. Indicate the features of critical flow? Deduce the condition for minimum specific energy and the related expressions in rectangular channels?

b) If y_1 and y_2 are alternate depths in a rectangular channel show that $y_c = \frac{2y_1^2 y_2^2}{y_1 + y_2}$ and hence the specific energy $E = \frac{y_1^2 + y_1 y_2 + y_2^2}{(y_1 + y_2)}$ [7+8]

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 regosity coefficient of its bed. [15]

4. A jet of water having a velocity of 60 m/sec is deflected by a vane moving at 25 m/sec in a direction at 30^0 to the direction of jet. The water leaves the vane normally to the motion of the vane. Draw the inlet and outlet velocity triangles and find out the vane angles for no shock at entry and exit. Take the relative velocity at the exit as 0.8 times the relative velocity at the entrance. [15]

5. The buckets of a Pelton impulse turbine deflect the jet through a total angle of 165^0 and owing to surface friction the relative velocity of water leaving the bucket is 0.85 times that at entry. Draw the velocity vector diagram at entry and exit and find the ratio of bucket velocity to jet velocity in order that the water shall leave the buckets with out whirl. In such a turbine the available head at the nozzle is 160 m, the coefficient of velocity for the nozzle is 0.97, the jet diameter 100 mm and mean bucket diameter 1.2 m. Using the conditions referred to above, determine
a) Best running speed in r p m
b) Impulsive force of the buckets at this speed
c) Power developed by the buckets
d) Efficiency of buckets. [15]

6.a) What is Thoma's cavitation factor? What is its significance?

b) A Francis turbine working under a head of 5 m at a speed of 210 rpm develops 75 KW when the rate of flow of water is 1.8 m^3/ sec. If the head is increased to 16 m, determine the speed, discharge and power. [7+8]

7.a) Define a centrifugal pump. Explain the working of a single stage centrifugal pump.

b) The water is to be pumped out of a deep well under a total head of 90 m. A number of identical pumps of design speed 1000 rpm and specific speed 900 rpm with a rated capacity of 150 lps are available. How many pumps will be required and how should they be connected? [7+8]

8. The load on a hydel plant varies from a minimum of 10,000 kW to a maximum of 35,000 kW. Two turbo-generators of capacities 22,000 kW each have been installed. Calculate
a) Total installed capacity of the plant
b) Plant factor
c) Maximum demand
d) Load factor. [15]

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SET No - 3

II B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
HYDRAULICS AND HYDRUALIC MACHINES
(CIVIL ENGINEERING)

Time: 3hours **Max. Marks: 75**

Answer any FIVE questions
All Questions Carry Equal Marks
- - -

1.a) What is specific energy curve? Explain it in detail along with a neat sketch.
b) A rectangular channel of width 4 m carries a discharge of 10 m^3/s. Plot the specific energy diagram and use it to find the critical depth and alternate depth to a depth of 0.7 m. What is the specific energy for this depth Assume $\alpha = 1.09$. Use the following depths of flow for computations and drawing the graph: 0.6, 0.7, 0.8, 1.1 and 1.4 m [7+8]

2.a) Write down the uses of hydraulic jump
b) Define rapidly varied flow and gradually varied flow
c) Derive the equation for specific energy curve. [4+4+7]

3. By dimensional analysis obtain an expression for the drag force R on a partially submerged body moving with a relative velocity V in a fluid; the other variables being the linear dimension l, height of surface roughness K, fluid density ρ, and the gravitational acceleration g. [15]

4.a) State and explain momentum equation. What are the practical applications of it?
b) A jet of water 75 mm diameter strikes a curved plate at its center with a velocity of 20 m/sec. The curved plate is moving with a velocity of 8 m/sec in the direction of the jet. The jet is deflected through an angle of 165^0. Assuming the plate to be smooth. Find
i) Force exerted on the plate in the direction of jet
ii) Power of the jet and
iii) Efficiency of the jet. [7+8]

5.a) Write a detailed note on efficiencies of turbine.
b) A turbine is to operate under a head of 30 m and a speed of 300 rpm. The discharge is 10 cumecs. If the efficiency of the turbine is 90%, determine
i) The specific speed of the turbine
ii) Power generated and
iii) Type of turbine. [6+9]

6.a) Distinguish between specific speed and unit speed of a turbine.
b) What are the different types of governors? Explain them. [8+7]

7.a) If a centrifugal pump does not deliver any water when started, what may be the probable causes and how can they be remedied?
b) The impeller of a centrifugal pump is 35 cm outside diameter and 17.5 cm internal diameter. The vane angles of the impeller at inlet and outlet are 30^0 and 25^0 respectively. The pump runs at 1400 rpm. The velocity of flow through the impeller is constant. Find the work done by the impeller per second per kg of water. [6+9]

8.a) Explain in detail the components of hydroelectric power plants.
b) Differentiate between Storage and Pondage. Support your answer with a neat sketches. [7+8]

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CODE NO: R09220103 | R09 | SET No - 4

II B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
HYDRAULICS AND HYDRUALIC MACHINES
(CIVIL ENGINEERING)

Time: 3hours **Max. Marks: 75**

Answer any FIVE questions
All Questions Carry Equal Marks
- - -

1.a) What is critical flow? Derive the condition for maximum discharge for a given value of specific energy.

b) The specific energy for a 6 m wide rectangular channel is to be 5 kg-m/kg. If the rate of flow of water through the channel is 24 m^3/s. Determine the alternate depths of flow. [7+8]

2.a) Explain the transition with raised bottom in a rectangular channel.

b) A uniform flow of $12m^3/s$ occurs in a long rectangular channel of 5 m width and depth of flow of 1.50 m. A flat hump is to be built at a certain section. Assuming a loss of head equal to the upstream velocity head, compute minimum height of the hump to provide a critical flow. [7+8]

3. A spillway model is to be built to a geometrically similar scale of 1/50 across a flume of 60 cm width. The prototype is 15 m high and the maximum head on it is expected to be 1.5 m.
a) What is the height of model and head should be used?
b) If the flow over the model at a particular head is 12 litres per second, what is the flow per m length for the prototype is expected?
c) If the negative pressure in the model is 20 cm, what is the negative pressure in prototype? Is it practicable? [15]

4.a) Find the expression for the force exerted by the jet on a flat vertical plate moving in the direction of the jet.

b) A jet of diameter 150 mm strikes a flat plate normally with a velocity of 20 m/s. The plate is moving with a velocity of 5 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) Wok done by the jet on the plate per second. [7+8]

5. Design a Pelton wheel for the following data.
a) Gross head available = 170 m
b) Losses in penstock = 10% of gross head
c) Power to be developed = 600 kW.
d) Speed of the wheel = 360 rpm
e) Overall efficiency = 86%
Assume any missing data suitably. [15]

6.a) Tests were conducted on a Francis turbine of 0.8 m diameter under a head of 9 m. The turbine developed 115 kW running at 240 rpm and consuming 1.2 m^3/sec. If the same turbine is operated under a head of 16 m predict its new speed, discharge and power.

b) What are the requirements of a governor in hydropower Installation? [9+6]

7.a) What is the function of the following in a centrifugal pump:
i) Foot valve
ii) Impeller
iii) Delivery valve

b) What are the methods of converting high velocity at impeller periphery in pumps to high pressure?

c) A four stage pump is required to pump 20.5 lps of water against a head of 125 m at 2400 rpm. Find the specific speed of the pump. [6+4+5]

8.a) Compare and contrast between hydropower station and thermal power station.

b) List out important hydropower plants in India. [9+6]

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