Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Fourth Semester B.Tech. (Civil Engineering)

Summer - 2017

Course Code: CEU 405

Course Name: Open Channel Flow and Hydraulic Machine

Time: 2 Hrs. 30 Min.   **Max. Marks: 60**

Instructions to Candidate
1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1. A   Differentiate between Gradually varied flow and   2
        Rapidly varied flow.

   B   Find the rate of flow for a rectangular channel
        of 7.5 m wide for uniform flow at a depth of   4
        2.25 m. The channel is having bed slope as 1 in
        1000. Take Chezy's constant C= 55. Also state
        whether flow is tranquill or rapid.

   OR

   Derive expression for critical depth and critical
   velocity.

   C   A trapezoidal channel has a side slopes of 3

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horizontal to 4 vertical and the slope of its bed is   6
1 in 2000. Determine the optimum dimensions
of the channel, if it is to carry water at 5 m³/s.
Take Chezy's constant 80.

2. A   Explain the meaning and types of floats?   3

   B   A discharge of 0.06 m³/s was measured over a
        right angled notch. While measuring the head   4
        over the notch, an error of 1.5mm was made.
        Determine the percentage error in the discharge,
        if the coefficient of discharge for the notch is
        0.6.

        OR

        In a rectangular channel of 0.5 m width, a
        hydraulic jump occurs at a point where depth of
        water flow is 0.15 m and Froude number is 2.5.
        Determine:
        i) The specific energy
        ii) The critical depth and subsequent depth
        iii) Loss of head, and
        iv) Energy dissipated.

   C   A 40 m long weir is divided into 12 equal bays   5
        by vertical posts, each 0.6 m wide. Using Francis
        formula, calculate the discharge over the weir if
        the head over the crest is 1.20 m and velocity of
        approach is 2 m/s.

3. A   Explain working of venturiflume with suitable   3
        sketch.

        OR

        Explain with sketches various Gradually Varied
        Flow surface profiles.

B. In a rectangular channel of width 24 m and depth of flow 6 m, the rate of flow of water is 86.4 m³/s. If the bed slope of the channel is 1 in 4000 , Find the slope of free surface of water. Take Chezy's Contant C= 60   4

C. Enumerate different dimensionless number and state their significance.   5

4. A   Define Hydraulic jump? What are its practical applications?   3

B. The characteristics of the spillway are to be studied by means of a geometrically similar model constructed to the scale ration of 1: 10.   4
    i)   If the maximum rate of flow in the prototype is 28.3 cumecs, what will be the corresponding flow in model?
    ii)   If the measured velocity in the model at a point on the spillway is 2.4 m/s, what will be the corresponding velocity in the prototype?
    iii) If the hydraulic jump at the foot of model is 50 mm high, what will be the height of jump in prototype?
    iv) If the energy dissipated per second in the model is 3.5 Nm, what energy is dissipated per second in the prototype?

OR

Explain the working of Pelton wheel turbine with suitable sketch.

C   A jet of water having velocity of 45 m/s impinges without shock on a series of vanes moving at 15 m/s. The direction of motion of   5

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vanes is inclined at 20° to that of the jet, the relative velocity at outlet is 0.9 of that inlet, and absolute velocity of water at exist is to be normal to the motion of vanes. Find

    i) Vane angles at inlet and outlet

    ii) Workdone per second per newton of water supplied by the jet, and

    iii) Hydraulic efficiency

5. A   A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m3/s. If the overall efficiency is 90 per cent, determine: 3

    i) Power generated

    ii) Specific speed of turbine

    iii) Type of turbine

OR

Define the following terms related with centrifugal pump

    i) Static head

    ii) Manometric head and

    iii) Total head

  B   Explain the working of submersible pump with sketch   4

  C   A single acting reciprocating pump, running at 50 rpm delivers 0.00736 m³/s of water. The diameter of the piston is 200 mm and stoke length 300 mm. The suction and delivery heads are 3.5 m and 11.5 m respectively, Determine: 5

    i) Theoretical discharge

    ii) Coefficent of discharge

    iii) Percentage slip of the pump and

    iv) Power required

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Summer – 2018

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Instructions to Candidate
1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
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4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1. a Differentiate between   2
      i) Subcritical and supercritical flow
      ii) Gradually varied flow and Rapidly varied flow

  b A trapezoidal channel having the side slope equal   4
to 60° with horizontal and laid on slope of 1 in 750, carries a discharge of 10 m³/s. Find the width at the base and depth of flow for most economical section. Take value of Chezy's coefficient C= 66.

OR
Derive the expression for critical depth and critical energy.

  c A 8 m wide channel conveys 15 m³/s of water at a   6

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depth of 1.2 m. Calculate:

    i) Specific energy of the flowing water;

    ii) Critical depth, critical velocity, and minimum specific energy;

    iii) Froude number and type of flow (Subcritical or supercritical flow) ✓

2. a   Describe briefly working of current meter with suitable sketch.   **2**

OR

Find an expression for the discharge over Cippoletti weir?

b   A discharge of 0.06 m³/s was measured over a right-angled notch. While measuring the head over the notch, an error of 1.5 mm was made. Determine the percentage error in the discharge, if the coefficient of discharge for the notch is 0.6.   **4**

c   A 40 m long weir is divided into 12 equal bays by vertical posts, each 0.6 m wide. Using Francis's formula, calculate the discharge over the weir if the head over the crest is 1.20 m and velocity of approach is 2 m/s.   **6**

3. a   Explain briefly working of venturiflume with suitable sketch.   **2**

OR

Describe briefly classification of various GVF surface profiles.

b   In rectangular channel of width 24 m and depth of flow 6 m, the rate of flow of water is 86.4 m³/s. If the bed slope of the channel is 1 in 4000, find the slope of the free water surface. Take Chezys constant C= 60   **4**

c   A 3.6 m wide rectangular channel conveys 9.0 m³/s of water with a velocity of 6 m/s.   **6**

    i) Is there a condition for hydraulic jump to occur? If so, calculate the height, length and strength of the jump.

    ii) What is loss of energy per kg of water?

4. a   Explain the meaning of Distorted models and Undistorted models   **2**

b   The performance of spillway of an irrigation project is to be studied by means of a model constructed to a scale of 1: 9, determine: **4**

    i) Rate of flow in model for a prototype discharge of 1200 m³/s;

    ii) The dissipation of energy in the prototype hydraulic jump, if the jump in the model dissipate 0.25 kW.

OR

An oil of specific gravity 0.92 and viscosity 0.03 poise is to be transported at the rate of 2500 lit/sec through a 1.2 m diameter pipe. Test were conducted on a 12 cm diameter pipe using water at 20°C. If the viscosity of water at 20°C is 0.01 poise. Find:

    i) Velocity of flow in the model;

    ii) Rate of flow in the model

c   A 75 mm diameter jet having a velocity of 30 m/s strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate,   **6**

    i) When the plate is stationary:

    ii) When the plate is moving with velocity of 15 m/s in the direction of jet, away from

Contd..

the jet

Also determine the power and efficiency of the jet when the plate is moving.

5. a Describe multistage pump with impeller in series.   2

b A centrifugal pump is to discharge 0.118 m³/s at a   4 speed of 1450 r.p.m. against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75 percent. Determine the vane angle at outer periphery of the impeller.

OR
A double acting reciprocating pump running at 50 r.p.m. has piston of diameter 30 cm and piston rod of diameter 5 cm and stroke length of 40 cm. The suction and delivery heads are 4 m and 14 m, respectively. Determine the theoretical discharge, and the power required the pump.

c i) Define followings with respect to turbine :   4
    1) Hydraulic efficiency
    2) Specific speed
    3) Speed ratio and flow ratio
    4) Inward flow reaction turbines

ii) Explain briefly working of jet pump.   2