HHM

UNIT 1

1) Explain geometrical parameters of a channel.
2) What is Chezy's formula? How it is derived?
3) Show that for a trapezoidal channel of given area of flow, the condition of maximum flow requires that hydraulic mean depth is equal to one half of the depth of flow.
4) State the condition under which the rectangular section is the most economical or most efficient. Derive these conditions.
5) A rectangular channel 7.5 m wide has a uniform depth of flow of 2.0m and has a bed slope of 1 in 3000. If due to weir constructed at the downstream end of the channel, water surface at the section is raised by 0.75m. Determine the water surface slope with respect to horizontal at this section. Assume n=0.02.
6) Derive the expression for constant velocity at all depth in case of open channel.
7) Derive the expression for constant velocity at all depth in case of open channel.
8) Derive the condition for maximum discharge through a circular channel.
9) Derive the expression for constant velocity at all depth in case of open channel.
10) Derive the condition for maximum discharge through a circular channel.

UNIT 2

1. Show that Chezy's coefficient $C=R^{1/6}/n$, where R is hydraulic radius and 'n' is Manning's roughness coefficient.
2. A metal plate of 10mm thickness and $200mm^2$ area is hung so that it can swing freely about the upper horizontal edge. A horizontal jet of water of 20mm diameter impinging with its axis perpendicular and 50mm below the edge of the hinge, and keeps it steadily inclined at 30 degree to the vertical. Find the velocity of the jet if the specific weight of the metal is $75.54kN/m^3$.
3. Explain the characteristics of surface profiles.
4. A rectangular channel 7.5 m wide has a uniform depth of flow of 2.0m and has a bed slope of 1 in 3000. If due to weir constructed at the downstream end of the channel, water surface at the section is raised by 0.75m.
5. Determine the water surface slope with respect to horizontal at this section. Assume n=0.02.show the relation between the alternate depths y_1 and y_2 in a rectangular channel can be expressed by $\frac{2y1^2\, y2^2}{(y1+y2)}=y_c^3$.

UNIT 3

1. Derive basic dynamic equation for gradually varied flow.
2. Explain the graphical integration method of varied flow equation.

3. Explain the following: (a) types of hydraulic jump (b) application of hydraulic jump (c) location of hydraulic jump.
4. Explain with neat sketch surge in open channels, types of surges.
5. Derive the equation for surge due to sudden increase of flow.
6. Derive the equation for surge due to sudden decrease of flow.
7. Derive the relation between water surface slopes and channel bottom slope.

UNIT 4

1. Explain the following: (a) types of hydraulic jump (b) application of hydraulic jump (c) location of hydraulic jump.
2. Explain with neat sketch surge in open channels, types of surges.
3. Derive the equation for surge due to sudden increase of flow.
4. Derive the equation for surge due to sudden decrease of flow.
5. Derive the relation between water surface slopes and channel bottom slope.

UNIT 5

1. A Francis turbine working under a head of 5m at a speed of 210 rpm; develops 75 kW when the rate of flow of water is $1.8m^3/s$. The runner diameter is 1m. If the head on this turbine is increased to 16m determine its new speed, discharge and power.
2. What is meant by cavitation? What is Thoma's cavitation factor and what its significance for water turbines?
3. Explain (i) Unit speed (ii) Unit discharge (iii) Unit power of hydraulic turbine. Derive expression for each of them.
4. What are the characteristic curves of hydraulic turbine? How are they useful to practical engineer?
5. How are small scale models useful in obtaining the characteristic curves for a proposed turbine of a hydroelectric installation?
6. Under what heading centrifugal pumps are classified.
7. What is meant by "priming" of a pump?
8. Explain different types of efficiencies of centrifugal pump.
9. Explain net positive suction head (NPSH).
10. Explain with neat sketches the working of a single stage centrifugal pump.

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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0021 Roll No.

B. Tech.

(SEM. IV) EXAMINATION, 2006-07

HYDRAULICS & HYDRAULIC MACHINES

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*

(2) Assume suitable data, if required.

1 Attempt any **four** parts of the following : **5×4=20**

(a) Define – Hydraulic mean radius, hydraulic depth, section factor and most efficient channel cross section.

(b) On what factors does the Manning's rugosity coefficient depends.

(c) Show that for a rectangular channel with given area is most efficient when hydraulic radius is half of the depth of the flow.

(d) Draw velocity distribution diagram in :

(i) horizontal and vertical sections in a rectangular channel

(ii) effect of curvature in channel.

(e) Obtain formulae for energy correction co-efficient in case of open channel flows.

(f) What do you understand by channel of constant velocity. Derive the relevant formulae.

2 Attempt any **two** parts of the following: **5×4=20**

(a) An open channel 3 m wide rectangular in shape carries the discharge at normal depth of 1.2 m. What should be the slope of channel if the Manning's 'n' is 0.014 ?

(b) Prove that the specific energy at critical condition is 1.5 times the critical depth.

(c) Draw the specific energy diagram and describe its various characteristics.

(d) Distinguish between sequent depth and alternate depth in an open channel flow.

(e) A wide rectangular channel carries a flow of 2.75 m^3/s per metre width, the depth of flow being 1.5m. Calculate the rise of the floor level required to produce a critical flow condition. What is the corresponding fall in surface level.

(f) Write an expression for specific force in a rectangular channel and obtain the condition for maximum discharge for a given specific force.

3 Attempt any **four** parts of the following : **5×4=20**

(a) List the assumptions made in the derivation of dynamic equation of gradually varied flow.

(b) Prove that the slope of free surface in gradually varied flow in open channel flow is given by :

$$\frac{dy}{dx} = \frac{s_o - s_f}{\left(1 - \frac{Q^2 T}{g A^3}\right)}$$

(c) Sketch the G.V.F. profiles produced on
(i) steep slope
(ii) critical slope.

(d) A wide rectangular channel 8 m wide is to be laid at a slope of 1/64 and carries a discharge of 40 m^3/s. A barrier across the channel raises the water surface of 3 m just upstream of the barrier. Find the length of surface profile upto the hydraulic jump upstream. Assume Manning's rugosity coeff. As 0.025.

(e) Describe examples where (i) the upstream end becomes the control section in GVF.

(f) Show that the slope of free surface profile can be expressed by

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

Where symbols carry the conventional meaning.

4 Attempt any **two** parts of the following: **10×2=20**

(a) Hydraulic jump is sometimes used as energy dissipator 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 conditions' Froude Number.

(b) Describe axial and mixed flow pumps. Sketch different characteristic curves for centrifugal pump. How these curves can be used in selecting a pump ?

(c) A tidal estuary is flowing at the rate of 1.8 m/s and depth of flow is 2m. Owing to the tide in the sea the level of water rose rapidly and

the resulting surge took one hour to reach 19.8 km upstream. Compute the height of the bore above the initial depth of bore. Also determine the speed and direction of the flow after the bore has passed.

5 Attempt any **two** parts of the following : **10×2=20**

(a) Draw neat sketches of various shapes of draft tubes. Also, explain the theory of draft tube.

(b) (i) Define and explain – hydraulic efficiency, mechanical efficiency and overall efficiency in case of turbines. What is the relationship between these three ?

(ii) A Pelton wheel develops 4500 kW under a net head of 125 m while running at a speed of 200 rpm. Assuming $\mathbf{K_v}$ = 0.98, speed ratio $\mathbf{K_u}$ = 0.46 and overall efficiency η_0 = 88%, the ratio of nozzle dia to pitch circle dia (d/D)=1/9 determine (a) discharge required (b) dia of wheel (c) the diameter and no. of jets required.

(c) An inward flow reaction turbine discharges radially and the velocity of flow is constant and equal to the velocity of discharge from the turbine. Show that hydraulic efficiency is given by

$$\eta_H = \frac{1}{\left\{\frac{1 + 1/2 \tan^2 \alpha}{\left(\frac{1 - \tan\alpha}{\tan\theta}\right)}\right\}}$$