**DEPARTMENT OF HARBOUR & OCEAN ENGINEERING**

**COURSE : APPLIED COASTAL HYDRAULICS AND HYDRAULIC**

**MACHINERY(HE403)**

**YEAR/ SEMESTER: 2ND /IV**

**UNIT – I-OPEN CHANNEL FLOW**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. Define prismatic and non-prismatic channel?
2. Classify different types of open channels?
3. What is meant by open channel flow?
4. Draw a typical velocity profile of an open channel flow?
5. Write down the expression for specific energy.
6. Define critical velocity.
7. Define Froude’s Number
8. Define Hydraulic Mean depth.
9. Define Reynolds number for open channel flow
10. Define average velocity profile.
11. Define ripples.
12. What are the applications of studying the flow through channels?
13. Define specific Energy and write down the equation?

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. Explain in detail with neat sketch - Classification of open channels with

examples

1. Differentiate between Uniform flow and Non-uniform flow with

examples.

1. Differentiate the flow properties for the manmade channels and natural

channels

1. What are the applications of studying the flow through channels?
2. Define the Reynolds number and differentiate between laminar and

turbulent flow.

1. What is Froude number? and write its significance?
2. What is the relation between average velocity and surface velocity in the open channels?
3. Discuss about the spatially varied flow with example.
4. Differentiate the steady flow with unsteady flow with examples

10. Explain the terms

(i) Specific Energy Diagram,

(ii) Critical depth and Normal depth.

(iii) Chezy's and Manning's formula for uniform flow.

11. Calculate the critical depth corresponding to a discharge of 10.2 m3/sec for the following cases :—

(i) Rectangular channel of width 4 m

(ii) Trapezoidal channel of bottom width 3 m and side slope 1 vertical to 1.25 horizontal.

1. Distinguish between specific force and specific energy in detail.
2. Discuss about regimes of flow with neat sketch.
3. A Prismatic rectangular open channel with a width of 5 m is discharging the seawater at the rate of Q = 50000 Litres/hour with the depth of flow is 3 m. Density of seawater = 1025 kg/m3 and kinematic viscosity = 1.136X10-6 N/m2. Find out NRe and NFe
4. Explain in detail with neat sketch about the classification of open channels with examples.
5. A Prismatic rectangular open channel is discharging the seawater volume of Q = 50000 Litres/hour, channel width of 5 m and depth of flow is 3 m. Density of seawater = 1025 kg/m3 and kinematic viscosity = 1.136X10-6 N/m2. (i) Find out NRe and NFe

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. (a) Describe and derive the expression for specific energy in the open channel and draw the specific energy curve with neat sketch. (6 marks)

(b) A Prismatic rectangular open channel is discharging the seawater volume of

Q = 50000 Litres/hour, channel width of 5 m and depth of flow is 3 m. Density of seawater = 1025 kg/m3 and kinematic viscosity = 1.136X10-6 N/m2. (i) Find out NRe and NFe and (ii) State the flow condition

1. (a) Draw the neat sketch for the velocity distribution in natural channels and rectangular channels and typical velocity profile.

(b) What is meant by one dimension method of open channel flow analysis and derive the expression for kinetic energy and momentum for the open channel flow?

(c) Write about the kinetic energy correction factor and momentum correction factor and their values.

1. (a) A prismatic rectangular open channel, width = 100 m, depth = 5 m, Discharge Q = 6000 m3/hour is branched with many semi circular channel. How many semicircular channels are possible to make with radius of 5 m by maintaining the same flow velocity?

(b) Describe and derive the equations for critical depth, critical velocity and minimum energy in terms of critical depth.

**5.** Find the diameter of a circular sewer pipe which is laid at a slope of 1 in 8000 and carried a discharge of 800 litres/s when flowing half full. Take the value of Manning’s N = 0.020.

**6.** Find the bed slope of trapezoidal channel of bed width 4 m, depth of water 3 m and side slope of 2 horizontal to 3 vertical, when the discharge through the channel is 20 m3/s. Take Manning’s N = 0.03 in Manning’s formula 

**7.** .A trapezoidal channel with a bed width of 4.0 m and side slopes of 1.5 H: 1 V carries a certain discharge. (A) Based on observation, if the critical depth of the flow is estimated as 1.70 m, calculate the discharge in the channel. (B) If this discharge is observed to be flowing at a depth of 2.50 m in a reach, estimate the Froude number of the flow in that reach.

**8.**calculate the critical depth and the corresponding specific energy for a discharge of 5.0 m3/sec in the following channels:

* + - * 1. Rectangular channel, B = 2.0 m
        2. Triangular channel, m = 0.5
        3. Trapezoidal channel, B = 2.0 m, m = 1.5

1. Fill in the missing data in the following table relating critical depth in Trapezoidal channels:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Case | Slope, m (m) | Width, B (m) | Critical depth, YC (m) | Discharge, Q (m3/s) | Specific Energy EC (m) |
| (a) | 1.5 | 3.5 | - | 5.0 | - |
| (b) | 2.0 | 2.0 | 3.0 | - | - |
| (c) | 1.5 | - | 4.0 | 2.641 | - |

1. Explain the classification of flow in open channel and write a note on the velocity distribution in the open channel flow with required sketch.
2. Fill in the missing data in the following table connected with critical depth computation in rectangular channels:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Case | Discharge, Q (m3/s) | Width, B (m) | Critical depth, YC (m) | Specific Energy EC (m) |
| (a) | - | 3.0 | .50 | - |
| (b) | 5.60 | - | 0.80 | - |
| (c) | 7.50 | 2.5 | - | - |
| (d) | - | 2.0 | - | 0.6 |

1. A rectangular channel 3.6 m wide had badly damaged surfaces with Manning's n = 0.030. As a first phase of repair, its bed was lined with concrete with n = 0.015. If the depth of the flow remains same at 1.2 m before and after the repair, what is the increase of discharge obtained as a result of repair?

14. A rectangular open channel has the following details : —

(1) Discharge — 16m3/sec.

(2) Bed width = 10 m

(3) Depth of water = 1.0 m.

Find :

(i) Specific Energy

(ii) Critical depth

(iii) Critical velocity

(iv) Minimum specific energy required for this discharge.

1. What is specific energy ? Draw and explain specific energy vs. depth of flow graph at a constant discharge in a rectangular channel.

16. Calculate the critical depth corresponding to a discharge of 10.2 m3/sec for the following cases :

(i) Rectangular channel of width 4 m

(ii) Trapezoidal channel of bottom width 3 m and side slope 1 vertical to 1.25 horizontal.

17. A rectangular open channel has the following details :

(1) Discharge = 1 6 m3/sec

(2) Bed width = 10 m

(3) Depth of water = 1.0 mts.

Find:

(i) Specific energy -

(ii) Critical depth

(iii) Critical velocity and

(iv) Minimum specific energy required for this discharge

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1. Explain in detail with neat sketch about the classification of open channels with examples.
2. Describe and derive the equations for critical depth, critical velocity and minimum energy in terms of critical depth for the flow through open channel.

**UNIT – II-UNIFORM FLOW**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. Define critical depth and critical velocity.
2. List out the different types of lining materials.
3. Define specific Energy ? and write down the equation.
4. Discuss about Most Economical section of channels.
5. What are different shape of channels ?
6. Write down the condition for most economical Circular channel with condition for maximum velocity.
7. Write down the condition for most economical Trapezoidal channel.
8. Write down the Darcy-weisbech formula for open channel.
9. What is the relation between Manning’s and Chezy’s Number for open channel?
10. Discuss about the roughness of the channel? and relative roughness.
11. What is Manning’s Number?
12. Define uniform flow?
13. State momentum equation?
14. What is meant by most economical channel?
15. Explain the term Hydraulic mean depth?
16. Write down the Chezy and manning’s formula for uniform flow.
17. Discuss about most economical channel.
18. Give an example for GVF and RVF.

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. i). Derive expression for Chezy equation for uniform flow?

ii). Find the velocity of flow and rate of flow of water through a rectangular channel of 6 m wide and 3 m deep, when it is running full. The channel is having bed slope as 1 in 2000. Take Chezy’s constant C = 55.

1. Find the discharge through a trapezoidal channel of width 8 m and side slope of 1 H: 3 V? The depth of water is 2.4 m and chezy’s constant, C = 50. The slope of bed of the channel is given 1 in 4000.
2. A rectangular channel carries water at the rate of 400 litres/s when bed slope is 1 in 2000. Find the most economical dimensions of the channel if C = 50.
3. A trapezoidal channel has side slope of 1 H: 2 V and the slope of the bed is 1 in 1500. The area of the section is 40 m2. Find the dimensions of the section if it is most economical. Determine the discharge of the most economical section if C = 50.
4. Derive the Expression for the Chezy’s formula for uniform channel with neat sketch.
5. Derive the Expression for Most Economical Rectangular channel.
6. Derive an expression for the most economical rectangular channel.
7. The discharge of water through a rectangular channel of width 8 m, is 15 m3/s, when the depth of flow of water is 1.2 m. Calculate the specific energy of the flowing water.
8. Derive the Expression for the Chezy’s formula for uniform channel with neat sketch
9. The discharge of water through a rectangular channel of width 8 m, is 15 m3/s, when the depth of flow of water is 1.2 m. Calculate the specific energy of the flowing water.

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. Derive the conditions for the most economical Circular channel with condition for maximum velocity.
2. Derive the conditions for the most economical   
   Trapezoidal channel.
3. A rectangular channel 4 m wide has depth of water 1.5m, the slope of the bed of the channel is 1 in 1000 and Chezy Number C = 55, it is desired to increase the discharge to maximum by changing the dimension of the section for constant area of cross sections. Find the new dimension of the channel and increased discharge ?
4. A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and the slope of the bed is 1 in 1500. The area of the section is 40 m2. Find the dimensions fo the section if it is most economical. Determine the discharge of the most economical section if C = 50.
5. A concrete lined circular channel of diameter 3 m has a bed slope of 1 in 500. Work out the velocity and flow rate for the conditions of (i) maximum velocity and (ii) maximum discharge. Assume Chezy’s C = 50.
6. The discharge of water through a rectangular channel of width 8 m, is 15 m3/s, when the depth of flow of water is 1.2 m. Calculate: (i) Specific energy of the flowing water, (ii) Critical depth and critical velocity, and (iii) Value of minimum specific Energy.
7. What do you understand by a most economical section of a channel ? Derive the condition of most economical section for a trapezoidal channel.
8. A trapezoidal channel carries a discharge of 2.5 m3/s. If the bed slope is 1 in 5000 and sides of the channel slope at 1 H to 0.5 V design the most economical section for this channel. Assume Manning's n = 0.02.
9. The width of a rectangular channel is reduced from 3.2 m to 2.5 m and the floor is raised by 0.25 m in elevation at a given section. If the depth of flow upstream of the construction is 2.0 m and the drop in the water surface elevation is 0.20 m, calculate the discharge in the channel if the energy loss is 1/10 of the upstream velocity head.
10. A rectangular channel 4 m wide has depth of water 1.5m, the slope of the bed of the channel is 1 in 1000 and Chezy’s number C = 55, it is desired to increase the discharge to maximum by changing the dimension of the section for constant area of cross sections. Find the new dimension of the channel and increased discharge.
11. A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and the slope of the bed is 1 in 1500. The area of the section is 40 m2. Find the dimensions of the section if it is most economical. Determine the discharge of the most economical section if C = 50.

**UNIT – III-NON-UNIFORM FLOW**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. Define Backwater curve and write down the profile condition.
2. Define dropdown curve and write down the profile condition.
3. Define the Length of backwater curve.
4. Discuss about characteristics of flow profiles.
5. List out different methods proposed for obtaining the solution of dynamic equation for Gradually varied flow.
6. Discuss about flow through channel transitions.

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. Discuss about back water curve and Affux.
2. Derive the Expression for the length of Backwater curve.
3. How the channels are classified according bed slope?
4. Discuss about different types of surface profiles with neat sketch?
5. Explain with a neat sketch M1, M2 and M3 profile for a gradually varied flow.
6. Differentiate between alternate depths and sequent depths.
7. Explain about following method computation of profiles
8. Direct step method
9. Standard Step method and
10. Graphical integration method
11. Discuss about flow through channel transitions
12. Explain in detail about contraction and expansion of channels, hyperbolic channel transition with neat sketch.
13. The depth of flow of water, at a certain section of a rectangular channel of 4 m wide, is 0.5 m. This discharge through the channel is 16 m3/s. If a hydraulic jump takes place on the downstream side, find the depth of flow after the jump.
14. How the channels are classified according bed slope?

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. Derive the dynamic equation for Gradually varied flow with neat sketch.
2. Determine the length of the backwater curve caused by an affux of 2.0 m in a rectangular channel of width 40 m and depth 2.5 m. The slope of the bed is given as 1 in 11000. Take Manning’s N=0.03
3. Explain in detail various gradually varied flow profiles in mild and steep channels.
4. State and discuss the assumptions made in the derivation of dynamic equation for gradually varies flow. Starting from first principle, derive the equation for the slope of the water surface in G.V.F. with respect to bed.
5. A rectangular channel 10 m wide carries a discharge of 30 m3/sec at a normal depth of 2.97 m. It is laid at a slope of 0.0001. If at a section in this channel the depth is 1.6 m, how far upstream or downstream from this section will the depth be 2.0 m ? Take Manning's n = 0.015. Classify the surface profile.
6. A rectangular channel conveying a discharge of 30 m3/sec is 12 m wide with a bed slope of 1 in 6000 and N = .025. The depth of flow at a section is 1.50. Find how far upstream or downstream of this section, the depth of flow will be 2.0 mts. Use step method. [Take only 2 steps]
7. State the assumption made in the derivation of dynamic equation for G.V.F. and derive the gradually varied flow equation in the following form :



1. A 9 m wide rectangular channel conveys 20 m3/s of water at a depth of 1.5 m. Calculate :

Specific energy of the flowing water.

Critical depth, critical velocity and minimum specific energy.

State whether the flow is subcritical or supercritical.

1. A rectangular channel 2.5 m wide carries a uniform .flow rate of 7.3 m3/s at a depth of 1.6 m. If a smooth hump of height 0.13 m is constructed at a certain location on the channel bed, determine the change in water surface elevation. Also compute the maximum permissible hump height if the upstream depth is not be altered.
2. A rectangular channel 8 m wide carries a discharged 25 m3/s. Bed slope is 0.0001. If at a section in this channel the depth is 1.7 m, how far upstream or downstream from this section the depth would be 1.9 m ? Taken = 0.015.
3. The depth of flow of water, at a certain section of a rectangular channel of 4 m wide, is 0.5 m. This discharge through the channel is 16 m3/s. If a hydraulic jump takes place on the downstream side, find the depth of flow after the jump.
4. Derive the dynamic equation for gradually varied flow with neat sketch.
5. Determine the length of the backwater curve caused by an affux of 2.0 m in a rectangular channel of width 40 m and depth 2.5 m. The slope of the bed is given as 1 in 11000. Take Manning’s N=0.

**UNIT – IV-HYDRAULIC JUMP**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. Define the term Hydraulic Jump with neat sketch.
2. Discuss about Spill Way and Sluice Gate.
3. Discuss about Weirs and Notches.
4. Discuss about Culverts.
5. Define the Length of Hydraulic Jump.
6. List out different types of Hydraulic Jump.
7. Discuss about loss of energy due to Hydraulic Jump? and write down the expression.
8. Differentiate between Affux and Hydraulic Jump.
9. Discuss about spill way.
10. Discuss about Culverts

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. Derive the expression for depth of hydraulic jump in terms of upstream Froude Number.
2. Explain in detail about Contraction and expansion of channels, hyperbolicchannel transition with neat sketch ?
3. List out the practical application of hydraulic Jump
4. Explain in detail different types of Hydraulic Jump with neat sketch
5. A sluice gate discharges water into a horizontal rectangular Channel with a velocity of 10 m/s and depth of flow of 1 m. Determine the depth of flow after the jump and consequent loss in total head.
6. Derive the expression for the loss of Hydraulic Jump
7. What is 'Hydraulic jump' in an open channel ? Write its applications.
8. Derive the expression for energy loss in hydraulic jump in terms of sequent depths.
9. Explain in detail about uses of hydraulic jump.
10. A sluice gate discharges water into a horizontal rectangular channel with a velocity of 10 m/s and depth of flow of 1 m. Determine the depth of flow after the jump and consequent loss in total head.
11. Explain in detail different types of Hydraulic Jump with neat sketch.
12. A sluice gate discharges water into a horizontal rectangular Channel with a velocity of 10 m/s and depth of flow of 1 m. Determine the depth of flow after the jump and consequent loss in total head.

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. Derive the expression for the depth of Hydraulic Jump with neat sketch
2. A hydraulic jump forms at the down stream end of spillway carrying 17.93 m3/s discharge. If the depth before jump is 0.80 m, determine the depth after the jump and energy loss?
3. The depth of flow of water, at a certain section of a rectangular channel of 4 m wide, is 0.5 m. This discharge through the channel is 16 m3/s. If a hydraulic jump takes place on the down stream side, find the depth of flow after the jump. For hydraulic jump in a rectangular channel derive equation relating sequent depths with initial Froude number.
4. Water from a low dam is released through a sluice gate on a horizontal rectangular channel. The depth of water upstream of the sluice gate is 16.0 m above the channel bed and the gate opening is 1.5 m. The sluice gate can be assumed to be a sharp edged (Cc = 0.6). If a free hydraulic jump is formed just downstream of the gate, find the sequent depths and the percentage of the initial energy lost in the jump.
5. Derive the expression for the loss of energy in the formation of a hydraulic jump in a rectangular channel.
6. A rectangular channel 5 m wide carries a discharge of 15 m3/sec. at a velocity of 10 m/sec. If a hydraulic jump occurs, find :

(i) Depth of flow after the jump

(ii) Energy loss in the jump

(iii) Height of jump.

1. Define hydraulic jump and derive the expression for energy loss in hydraulic jump in terms of sequent depths.
2. In a horizontal rectangular channel 1.5 m wide, if the observed depths before and after the jump are 0.2 m and 1.0 m respectively, determine the discharge flowing through the channel.

9. 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 at inlet section.

(ii) The sequent depth

(iii) Loss of head.

10.. A rectangular channel 5 m wide carries a discharge of 15 m3/s at a velocity of 10 m/s. If hydraulic jump occurs, find

(i) Depth of flow after the jump,

(ii) Energy loss in the jump and

(iii) Height of the jump.

1. A hydraulic jump forms at the downstream end of spillway carrying 17.93 m3/s discharge. If the depth before jump is 0.80 m, determine the depth after the jump and energy loss.
2. A hydraulic jump forms at the downstream end of spillway carrying 17.93 m3/s discharge. If the depth before jump is 0.80 m, determine the depth after the jump and energy loss?

**UNIT – V-PUMP AND TURBINE**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. Define Reciprocating pump and list the main parts with neat sketch.
2. Discuss about the classification of reciprocating pump.
3. Define NPSH and write their significance.
4. What is cavitation and what are their effects.
5. Define Centrifugal pump and list its main parts with neat sketch.
6. Define the different types of heads of a Centrifugal pump.
7. Define the different types of efficiencies of a centrifugal pump.
8. What is Turbine and Write about its classification?
9. Define the specific speed of the turbine and write down expression for it?
10. Explain about the jet propulsion of ships.

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. Comparison between centrifugal pump and reciprocating pump.
2. Draw the general layout of hydro electric power plant and define each components.

3.Explain in detail about Draft tube and their types.

4. Derive the expression for specific speed (Ns) of a turbine.

5. Explain Heads and Efficiencies of hydraulic turbines.

6. Why priming is required in centrifugal pumps ? Why can the suction lift of a pump not exceed a certain limit ?

7. What will be the discharge if the hydraulic efficiency of the pump is 94% 8. 8. Explain the parts and working of a Pelton wheel turbine.

Derive the expression for specific speed of turbine.

9. 1000 kW of power is being developed by a hydraulic turbine under a head of 20 m and gives 85% efficiency. Calculate the specific speed of the turbine.

10. Define the different efficiencies of a turbine and give the appropriate expression for each one of them.

11. Explain working of a centrifugal pump with neat sketch,

12. Derive the expression for specific speed of a turbine.

13. Differentiate between :

(i) Gross head and net head of a turbine,

(ii) Impulse turbine and Reaction turbine.

14.Write a short note on Multistage Centrifugal Pump.

15. Explain the principles of working of single acting and double acting reciprocating pumps.

16.Explain the working of a single acting reciprocating pump with a neat sketch.

1. Explain the function of air vessels fitted to a reciprocating pump.
2. Explain with a neat sketch the construction and working of a single acting reciprocating pump.
3. Write a short note on Multistage centrifugal pump.
4. For a Single acting reciprocating pump, Pistons diameter is 150 mm, stoke length is 300 mm, rotational speed is 50 rpm. The pump rises the water through 18 m. Determine the theoretical discharge, if the actual discharge is 4 liters per second. Also determine the volumetric efficiency, slip and actual power required to lift the water. Take mechanical efficiency of the pump is 80%.
5. Draw the general layout of hydro electric power plant and define its each components
6. Differentiate between centrifugal pump and reciprocating pump.
7. Draw the general layout of hydro electric power plant and define each components
8. Explain in detail about Reciprocation pump with neat sketch.

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

* 1. A single acting reciprocating pump, running at 50 r.p.m., delivers 0.01 m3/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine: (i) The theoretical discharge of pump ii) Coefficient of discharge and iii) Slip and the percentage of the pump iv) Power required to drive the single acting pump?
  2. Find the number of pumps required to take water from a deep well under a total head of 89 m. All the pumps are identical and are running at 800 r.p.m. The specific speed of each pump is given as 25 while the rated capacity of each pump is 0.16 m3/s.
  3. Find the power required to drive a centrifugal pump which delivers 0.04m/s of water to a height of 20 m through a 15 cm diameter pipe and 100 m long. The overall efficiency of the pump is 70% and co-efficient of friction ‘f’= 0.15 in the formula : hf = 4 fLV2/(d x 2g).
  4. A Pelton tubine develops 3000 kW under a head of 300 m. The overall efficiency of the turbine is 83%. If speed ratio = 0.46, Cv = 0.98 and specific speed is 16.5, then find (i) Diameter of the tubine, and (ii) Diameter of the jet
  5. A Pelton wheel has a mean bucket speed o 10 meters per second with a jet of water flowing at the rate of 700 litres/s under a head of 30 metres. The buckets deflect the jet through an angle of 1600. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98.
  6. A nozzle of 50 mm diameters delivers a stream of water at 20 m/s perpendicular to a plate that moves away from the jet at 5m/s. Find: (i) The force on the plate, (ii) the work done , and (iii) the efficiency of jet.
  7. A jet of water of 2.5 cm diameter, moving with a velocity of 10 m/s. strikes a hinged square plate of weight 98.1 N at the centre of the plate. The plate is uniform thickness. Find the angle through which the plate will swing?
  8. At the design speed of 1000 rpm at centrifugal pump is to deliver water against a head of +5.0 m. The vanes are curved backwards to an angle of 30° with the periphery. The impeller diameter is 30 cm, the outlet width is 5 cm.
  9. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m3/sec. If the efficiency is 90%, determine:

(i) Specific speed of the machine

(ii) Power generated

(iii) Type of turbine

(iv) Performance under a head of 20 mts.

* 1. Define critical slope of channel and draw possible water surface profiles when the flow over mild slope is followed by a steep slope.

11. A single acting reciprocating pump runs at 60 r.p.m. The diameter of the plunger is, 1,5 cm and crank radius is 15 cm. The suction pipe is 10 cm in diameter and 5 m long. Calculate maximum permissible value of suction lift Hs if separation takes place at 2.6 m of water absolute.

12.A centrifugal pump lifts water against a static head of 40 m, of which 4 m is suction lift. The suction and delivery pipes are both 15 cm diameter; the head loss in a suction pipe is 2.3 m and in the delivery pipe is 7.4 m. The impeller is 42 cm diameter and 2.5 cm wide al the mouth, it revolves at 1200 r.p.m. and its effective vane angle it exist is 35°. If ηmano = 82% and η0 = 72% determine the discharge delivered by the pump and power required to drive the pump.

13.A hydraulic turbine develops 880 kW under a head of 20 m and gives an efficiency of 90%. Calculate the specific speed of the turbine. Calculate the power generated if the head is reduced to 15 m. Assume N = 400 rpm.

14.A centrifugal pump is discharged .118 m3/sec at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 25 cm, its width at outlet is 5 cms and the manometric efficiency is 0.75. Determine the Vane angle at the outer periphery of the impeller

15. A power house is to develop a total of 70 MW of electrical energy. It is proposed to use four Pelton wheel turbines, each to work under the following specifications :—

(i) Head = 400 r.p.m.

(ii) Speed = 250 r.p.m.

(iii) Overall efficiency = 0.9

(iv) Coefficient of velocity = 0-98

(v) Speed ratio = 0.45.

16. A reaction turbine working under a head of 100 m and at a speed of 700 rpm has an overall efficiency of 80%. If the specific speed is 175, calculate the discharge, what would be required if the head is reduced to 80 m ?

17. Write short notes on any three of the following :-

(a) Centrifugal pump troubles and remedies,

(b) Double acting reciprocating pump,

(c) Selection of turbines.

(d) Classification of hydraulic jumps.

(e) Froude's model law.

18. A single acting reciprocating pump has a plunger of diameter 50 cm and a stroke of 80 cm. If the speed of the pump is 60 rpm and coefficient of discharge is 0.97, determine the actual discharge and the percentage slip of the pump.

19. A single acting single cylinder reciprocating pump has the following characteristics :

(i) Diameter of the cylinder = 20 cm

(ii) Stroke length = 45 cm

(iii) Actual discharge = 6.5 Ips

(iv) Suction head = 5.0 mts

(v) Delivery head = 20.0 mts

(vi) Speed *=* 40 rpm

Find the coefficient of discharge, percent slip and power required to drive the pump.

1. A centrifugal pump is running at 1200 r.p.m. The outlet vane angle of the impeller is 30° and velocity of flow at outlet is 4 m/s. The pump is working against a total head of 30 m and the discharge through the pump is 0.3 m3/s. If the manometric efficiency of the pump is 70%, determine

(i) the diameter of the impeller and

(ii) the width of the impeller at outlet. 8

1. Explain in detail about classification of turbines and discuss about components of Pelton wheel turbine with neat sketch.
2. Explain in detail about Centrifugal Pump and their different components with neat sketch

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