DEPARTMENT OF CIVIL ENGINEERING
CE 8403 APPLIED HYDRAULIC ENGINEERING

Important Two Mark Questions with Answers

UNIT-1 UNIFORM FLOW

1.Define open channel.

A liquid flowing at atmospheric pressure through a passage is known as flow in open channels. The flow of water through pipes at atmospheric pressure or when the level of water in the pipe is below the top of the pipe, is also classified as open channel flow

2. What are the classifications of flow in an open channel?

- Steady and unsteady flow
- Uniform flow and non-uniform flow
- Laminar flow and turbulent flow
- Sub-critical, critical, and super critical flow

3. Define steady flow and unsteady flow.

Steady Flow

If the flow characteristics such as depth of flow, velocity of flow, rate of flow at any point in open channel flow do not change with respect to time, the flow is said to be steady flow.

$\partial v/\partial t = o$ **or** $\partial Q/\partial t = 0$ **or** $\partial y/\partial t = 0$

Unsteady Flow

If at any point in open channel flow, the velocity of flow, depth of flow or rate of flow at any point in open channel flow changes with respect to time, the flow is said to be steady flow

$\partial v/\partial t \neq o$ **or** $\partial Q/\partial t \neq 0$ **or** $\partial y/\partial t \neq 0$

4. Define Uniform flow and Non-Uniform flow.

Uniform flow

If for a given length of the channel, the velocity of flow, depth of flow, slope of the channel and cross-section remain constant, the flow is said to be uniform.

$\partial v/\partial S, = 0$ $\partial y/\partial S = 0$

Non – uniform flow

If for a given length of the channel, the velocity of flow, depth of flow, slope of the channel and cross-section do not remain constant, the flow is said to be non - uniform flow.

$\partial v/\partial S \neq 0$ $\partial y/\partial S \neq 0$

5. What is rapidly varied flow?

It is defined as that flow in which depth of flow changes abruptly over a small length of the channel.

6. What is gradually varied flow?

If the depth of flow in a channel changes gradually over a long length of the channel, the flow is said to be gradually varied flow.

7. What is laminar and turbulent flow?

Laminar flow

The flow in open channel is said to be laminar if the Reynolds number (Re) is than 500 or 600 Reynolds number = μ ρVR

Turbulent flow

If the Reynolds number is more than 2000, the flow is said to be turbulent in open channel flow.

8. What is TRANSITION state?

If the Re lies between **500 to 2000**, the flow is considered to be in transition state.

9. Give a brief note on frude number ,Sub-critical, Critical, Super critical flow.

Fe = V/√ (g D)

critical:

The flow in open channel is said to be critical if the Froude number is 1.

Sub-critical, :

The flow in open channel is said to be super critical if the Froude number is less than one.

Super critical flow:

The flow in open channel is said to be super critical if the Froude number is greater than

10. Give the formula relating to velocity and discharge in chezy's formula.

Velocity V = C √mi

Discharge Q = A C√

(mi)

11. Give the BAZIN, GANGUILLET-KUTTER, MANNINGS formulas for chezy's constant. a) Bazin formula

$$C = \frac{157.6}{1.81 + \frac{K}{\sqrt{m}}}$$

b) ganguillet-kutter formula

$$C = \frac{23 + \frac{0.00155}{i} + \frac{1}{N}}{1 + (23 + \frac{0.00155}{i})\frac{N}{\sqrt{m}}}$$

c) Manning's formula

$$C = \frac{1}{N} m^{\frac{1}{6}}$$

12. Give the formula for total energy

$$\text{TOTAL ENERGY} = z + h + \frac{V^2}{2g}$$

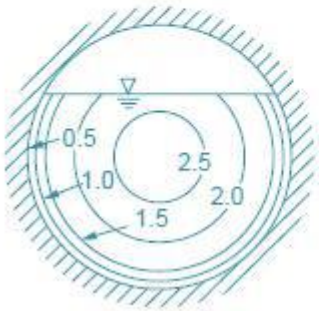
13. Define specific energy.

It is defined as energy per unit weight of the liquid with respect to the bottom of the channel.

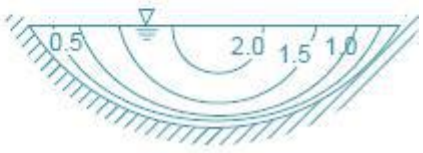
14. Draw the Velocity distribution in open channel sections

Triangular channel

Trapezoidal channel



Circular channel



Shallow ditch

15. Define uniform flow. Give examples.

Uniform flow is a fluid flow in which the velocity of any given instant does not change both in magnitude and direction with respect to space. Mathematically, Example:

Open channel flow with constant depth of water

Flow through uniform diameter pipes.

16. What are the instruments used for measuring velocity in open channels? [May'06, May'07May'08& May'09]

Velocity of flow is measured by various instruments such as Pitot tube, Current meter, hot wire anemometer, floats and Laser Doppler velocimetry.

17. What is cup type current meter?

In this type, series of conical cups called revolving element are mounted on a spindle vertically at right angle to the direction of flow.

18. Give some applications of laser Doppler Anemometer.

1. It is used for the flow between blades of a turbine.

2. It is used fin combustion and flame phenomena in gas turbines.

3. It is used in Jet propulsion systems.

4. It is used for measuring the blood flows.

5. In remote sensing of wind velocities.

19. List the factors affecting Manning's roughness coefficient. [Nov'08] The following factors affecting Manning's roughness coefficient are:

1. Surface roughness

2. Vegetation growth

3. Channel irregularities

4. Sitting and scouring

5. Stage (water surface elevation) and discharge

6. Transport of suspended and bed material.

20. What are the condition for obtaining most economical circular channel section for maximum velocity and discharge?

a. Condition for maximum velocity of circular section

(i) Depth of flow is 0.81 times the diameter of the circular channel.

(ii) Hydraulic radius is equal to 0.3 times the diameter of channel.

y wa ter surface from the centre, 20=257030'

b. Condition for maximum discharge of circular section

(iv) Depth of flow is 0.91 times the diameter of the circular channel.

(v) Hydraulic radius is equal to 0.286 times the diameter of channel.

(vi) Angle subtended by water surface from the centre, 20=3080.

21. Show that maximization of discharge required minimization of the wetted perimeter of the channel for a given area of flow.

For a given channel slope, roughness coefficient and area of flow, the maximum discharge of channel is obtained when the wetted perimeter is minimum.
If second derivative of *P* is positive, the condition of minimum *P* is obtained.

22. Define non-erodible channels.

Channels which are constructed from materials, such as concrete, masonry and metal can withstand erosion under all including most extreme conditions are called as non-erodible sections.

UNIT II GRADUALLY VARIED FLOW

1. Define varied flow. Explain its classification.

Flow properties, such as depth of flow area of cross section and velocity of flow vary with respect to distance is called Non-uniform flow.
It is, otherwise, called as varied flow. The varied flow is broadly classified into two types:
1) Rapidly varied flow (R.V.F)

2) Gradually varied flow (G.V.F)

2. Define gradually varied flow and rapidly varied flow in open channel. [Nov'07, May'08&Nov'08]

If the depth of flow changes quickly over a small length of the channel, the flow is said to be gradually varied flow (GVF). Example: Back water in a dam. Depth of water increases rapidly over a short length of the channel is called rapidly varied flow. Example: hydraulic jump.

3. State the assumptions made in the derivation of dynamic equation for gradually varied flow. [Nov'08]

The following assumptions are made for analyzing the gradually varied flow:
1. The flow is steady

2. The pressure distribution over the channel section is hydrostatic, i.e., streamlines are practically straight and parallel.

3. The head loss is same as for uniform flow.

4. The channel slope is small, so that the depth measured vertically is the same as depth measured normal to the channel bottom.

5. A channel is prismatic.

6. Kinetic energy correction factor is very close to unity.

8. The formulae, such as Chezy's formula, Manning's formula which are applicable, to the uniform flow are also applicable for the gradually varied flow for determining slope of energy line.

4. Distinguish between draw down and back water curves. [Nov'07, Nov'08&May'10]

When the depth of flow decreases along the flow direction becomes negative and the surface profile is called a drawdown curve. When the depth of flow (y) increases in the direction of flow, slope of water surface is positive (upward slope) and the water surface is known as Backwater curve.

5. Write the expression to determine the length of the backwater curve. (Nov'09)

6. What is backwater curve in gradually varied flow profile and give practical example for getting this type of profile. (Nov'06)

When the depth of flow (y) increases in the direction of flow, slope of water surface is positive (upward slope) and the water surface is known as Backwater curve. Due to obstruction (dam), the water level raises and it has maximum depth of water near to the dam as shown in figure is an example for back water curve.

If the flow in the channel is uniform, the channel is said to have a normal slope denoted by *Sn*.

8. What are the flow profiles possible in mild sloped channels?

1. Flow behind an overflow weir.
2. Flow Over a free overall
3. Flow downstream of a sluice gate.

9. Classify surface profiles in a channel. [May'08&Nov'06]

Based on channel slopes, channels can be classified into five types as stated earlier.

1. Mild slope (M)
2. Critical slope (C)
3. Steep slope (S)
4. Horizontal slope (H)
5. Adverse slope (A)

10. What are the methods used to determine the length of surface profile?

Length of surface profile determined with the help of any one of the following methods.

1. Graphical Integration method.

2. Direct step method.

3. Standard step method.

11. Define the Afflux.

Afflux is defined as the maximum increase in water level due to obstruction in the path of flow of water.

12. What is transition in open channel?

Transition means a change of channel cross section.

(i) Provision of a hump pr depression along depth and

(ii) Contraction or expansion of channel width, in any combination.

13. Write down the applications of transition.

Transition in open channel flow is made to measure discharge of channel. Generally, discharge, = Area (A) x Velocity (V). For discharge calculation, both cross section of flow and velocity are necessary. With the help of channel transition, discharge of water obtained from measured flow cross section dimensions and / specific energy equations.

jum **p in horizontal bed channel?**

The rise of water level which takes place due to the transformation of the shooting to the streaming flow is known as hydraulic jump.

15. Write the expression for hydraulic jump?

17. **State the uses of hydraulic jump.**
18. The kinetic energy of flow after the hydraulic jump is greatly reduced, which may prevent erosion of the channel boundaries of downstream side.

18. Explain the classification of hydraulic jumps.

Based on Froude number (F), hydraulic jump can be classified into 5 types.
a. Undulation jump: The Froude number F ranges from 1 to1.7 and the liquid surface does not rise shortly but having undulations of radically decreasing size.

b. Weak jump: The Froude number F ranges from1.7 to 2.5 and the liquid surface remains smooth.

c. Oscillating jump: The Froude number F ranges from 2.5 to 4.5 and there is an oscillating jet which enters the jump bottom and oscillating to the surface.

d. Steady jump: The Froude number F ranges from 4.5 to9 and energy loss due to steady jump in between 45 and 70%.

e. Strong jump: The Froude number greater than 9 and the downstream water surface is rough. Energy loss due to strong jump may be up to 85%.

19. Define surges.
When the flow properties, such as discharge or depth varies suddenly is called surge.
Example: sudden closure of gate.

20. What are meant by positive and negative surges?

1. Positive surge – a surge producing increase in depth

2. Negative surge – a surge producing decrease in depth.

21. Define the term backwater curve.
The profile of the rising water on the upstream side of the dam is called backwater curve. The distance along the bed of the channel between sections where water is having maximum height is known as length of back water curve.

UNIT 3 RAPIDLY VARIED FLOW

1 What is rapidly varied flow?

It is defined as that flow in which depth of flow changes abruptly over a small length of the channel.

2 define Hydraulic jump
A hydraulic jump is a phenomenon in the science of hydraulics which is frequently observed in open channel flow such as rivers and spillways. When liquid at high velocity discharges into a zone of lower velocity, a rather abrupt rise occurs in the liquid surface.
3. State the uses of hydraulic jump. [Nov'06, Nov'07 & May'10]

The kinetic energy of flow after the hydraulic jump is greatly reduced, which may prevent
bounda ries of downstream side.

Based on Froude number (F), hydraulic jump can be classified into 5 types.

a. Undulation jump: The Froude number F ranges from 1 to1.7 and the liquid surface does not rise shortly but having undulations of radically decreasing size.

b. Weak jump: The Froude number F ranges from1.7 to 2.5 and the liquid surface remains smooth.

c. Oscillating jump: The Froude number F ranges from 2.5 to 4.5 and there is an oscillating jet which enters the jump bottom and oscillating to the surface.

d. Steady jump: The Froude number F ranges from 4.5 to9 and energy loss due to steady jump in between 45 and 70%.

e. Strong jump: The Froude number greater than 9 and the downstream water surface is rough. Energy loss due to strong jump may be up to 85%.

5. Define surges.

When the flow properties, such as discharge or depth varies suddenly is called surge.

Example: sudden closure of gate.

6. What are meant by positive and negative surges? [Nov'07]

1. Positive surge – a surge producing increase in depth

2. Negative surge – a surge producing decrease in depth.

7. What is TRANSITION state?

If the Re lies between **500 to 2000**, the flow is considered to be in transition state.

8. Give a brief note on frude number ,Sub-critical, Critical, Super critical flow. Fe = V/√ (g D)

critical:

The flow in open channel is said to be critical if the Froude number is 1.

Sub-critical, :

The flow in open channel is said to be super critical if the Froude number is less than one. **Super critical flow**:

The flow in open channel is said to be super critical if the Froude number is greater than

9. Give the formula relating to velocity and discharge in chezy's formula.

Velocity V = C √mi

Discharge Q = A C√ (mi)

10. Give the BAZIN, GANGUILLET-KUTTER, MANNINGS formulas for chezy's constant. a) Bazin formula

rmula

$$C = \frac{23 + \frac{0.00155}{i} + \frac{1}{N}}{1 + (23 + \frac{0.00155}{i})\frac{N}{\sqrt{m}}}$$

c) Manning's formula

$$C = \frac{1}{N} m^{\frac{1}{6}}$$

11. Give the formula for total energy

$$\text{TOTAL ENERGY} = z + h + \frac{V^2}{2g}$$

12. Define specific energy.

It is defined as energy per unit weight of the liquid with respect to the bottom of the channel.

UNIT-4 TURBINES

1. What do you mean by turbine?

The hydraulic machine which convert the hydraulic energy in to mechanical energy is called
turbine

2. Define pump:

It is defined as the hydraulic machine which converts mechanical energy in to hydraulic energy

3. Explain net head

It is defined as the head available at the inlet of turbine .If Hf is the loss due to friction between water and penstock then net head

H=Hg-Hf

4. Define Hydraulic Efficiency:

It is defined as the ratio of power delivered to the runner to the power supplied at the inlet.

5.Define mechanical efficiency

It is defined as the ratio of power at the shaft of the turbine to the power delivered by the water to runner.

6. Define volumetric efficiency

It is defined as the ratio of volume of water actually striking the runner to the Volume of water supplied to the runner.

7. Define over all efficiency

It is defined as the ratio of shaft power by water power

8. Explain impulse turbine

If at the inlet of the turbine the energy available is only kinetic energy the turbine is known as impulse turbine.

urbin **e**

If at the inlet of the turbine the water possesses kinetic energy as well as pressure energy the turbine is known as reaction turbine.

10. Explain tangential flow turbine

If the water flows along the tangent of the runner, the turbine is known as the tangential flow turbine.

11. Explain radial flow turbine

If the water flows in the radial direction through the runner the turbine I called radial flow turbine.

12. Explain inward flow radial turbine

If the water flows from outwards to inwards radially the turbine is called inward radial flow turbine.

13. Explain outward flow radial turbine

If the water flows radially from inwards to outwards the turbine is known sa outward radial flow turbine.

14. Define axial flow turbine

If the water flows through the runner along the direction parallel to the axis of rotation of the runner the turbine is called axial flow turbine.

15. What is Pelton wheel:

Pelton wheel or Pelton turbine is a tangential flow impulse turbine. The water strikes the bucket along the tangent of the runner . The energy available at the inlet of the Turbine is only kinetic energy. This turbine is used for high heads.

16. What is breaking jet?

When the nozzle is completely closed, the amount of water striking the runner reduces to zero but the runner due to inertia goes on revolving for a long time to stop the runner in a short time a small nozzle is provided which direct the jet of water on the back of vanes .This jet of water is called breaking jet.

17. What is jet ratio?

It is the ratio of pitch diameter (D) to the diameter of jet (d).

18. What is Draft tube?

A tube or pipe of gradually increasing area is used for discharging water from the exit of the turbine to the tail race is called draft tube.

19. Define Degree of Reaction (R)

It is defined as the ratio of change of pressure energy inside the runner to the change of total energy out side the runner.

20. What is radial discharge?

This means the angle made by absolute velocity with the tangent on the wheel is and the component of whirl velocity is zero.

22. Define Francis turbine:

Inward flow reaction turbine having radial discharge at outlet is known as Francis Turbine

23. Define propeller turbine:

This is an example of axial flow reaction turbine . Here the vanes are fixed to the hub and are not adjustable.

24. Define Kaplan turbine:

This is an example of axial flow reaction turbine. Here the vanes are not fixed to the hub and are adjustable.

25. What are the uses of draft tube?

1. The net head on the turbine increases.
2. Due to increase in net head the power and efficiency of the turbine also increases.
3. The large amount of rejected kinetic energy is converted in to useful pressure energy

26. What are types of draft tube?

1. Conical draft tube

3. Mood y spreading tube

3. Draft tube with circular inlet and rectangular outlet.

27. What are the types of characteristic curves?

1. Main characteristic curves

2. Operating characteristic curve
3. Muschel characteristic curves

28. What is specific speed of the turbine?

It is defined as the speed of a turbine which will develop unit power under unit head.

29. Define unit quantities;

Unit quantities are the quantities which are obtained when the head on the turbine are unity.

30. Explain about characteristic curves of a hydraulic turbine

Characteristic curves of a hydraulic turbine are the curves with the help of which the exact behavior and performance of the turbine under different working conditions can be known.

31. What are the main parts of pelton wheel turbine?

1. Nozzle and flow regulating arrangement
2. Runner with buckets
3. Casing
4. Breaking jet

32. What are the main mechanisms of Radial flow reaction turbine?

1. Casing
2. Guide mechanism
3. Runner
4. Draft tube

33. **What are the classifications of hydraulic turbine according to the type of energy at inlet?**

(a) Impulse turbine and
(b) Reaction turbine

34. What are the types of turbine according to direction of flow through runner?

(a) Tangential flow turbine
(b) Radial flow turbine
(c) Axial flow turbine
(d) Mixed flow turbine

35. What are the types of turbine according to the head at the inlet of the turbine?

(a) High head turbine
(b) Medium head turbine
(c) low head turbine Where on e section is taken

36. What do you know about Hub or Boss?

It is the core part of the axial flow turbine where the vanes are attached.

37. Under what head the propeller turbine take water? About 100 m head the propeller turbine take water.

When the vanes are fixed to the hub and they are not adjustable the turbine is Called propeller turbine.

UNIT-V PUMPS

1. How are fluid machines classified?

Fluid machines are classified into 2 categories depending upon the direction of transfer of energy:

1. Turbines
2. Pumps or compressors.

2. What is centrifugal pump?

The hydraulic machines which convert mechanical energy in to pressure energy by means of centrifugal force is called centrifugal pump. It acts a reverse of inward radial flow turbine.

3. What are the main parts of centrifugal pump?

1. Suction pipe with foot valve and strainer
2. Impeller
3. Casing
4. Deliver y pipe

4. Write down the use of centrifugal pump?

1. Used in deep sump and basement
2. The high discharge capacity
3. It is driven by electric motors

5. Define multistage pump:

If centrifugal pump consists of two or more impellers the pump is called Multistage pump. To produce a high head impellers are connected in series .To produce high discharge impellers are connected in parallel.

6. What is Net Positive Suction Head (NPSH)?

NPSH is defined as the total head required making liquid flow through suction pipe to pipe impeller.

7. Define slip of a reciprocating pump and negative slip:

Slip is defined as the difference between theoretical discharges and actual discharge.
If actual discharge is greater than theoretical discharge negative value is found this negative value is called negative slip.

8. What do you know coefficient of discharge?

It is defined as the ratio of actual discharge b y theoretical discharge. It is denoted By Cd

9. What do you know Drop down curve?

The water surface has a convex profile upwards this curve is called drop down Curve.

10. What is separation of reciprocating pump?

If the pressure in the cylinder is below the vapour pressure , dissolved gasses will be liberated from the liquid and cavitations will takes place . The continuous flow of liquid will not ex it which means separation of liquid takes place. Th e pressure at which separation takes place is called separation pressure and head corresponding to the separation pressure is called separation pressure head.

11. What is an indicator diagram?

Indicator diagram is the graph between the pressure head and distance traveled b y the piston from inner dead center for one complete revolution.

12. What is Air vessel?

Air vessel is a closed chamber containing compressed air in the top portion and liquid at the bottom of the chamber . It is used to obtain a continuous supply of water at uniform rate to save a considerable amount of work and to run the pump at high speed with out separation.

13. What is the purpose of an air vessel fitted in the pump?

1. To obtain a continuous supply of liquid at a uniform rate.
2. To save a considerable amount of work in overcoming the frictional resistance in the suction and delivery pipes, and
3. To run the pump at a high speed with out separation.

14. What is the work saved by fitting a air vessel in a single acting, double acting pump?

cting pump the work saved is 39.2%.

15. What is Discharge through a Reciprocating Pump in per sec? For Single acting

Discharge (Q)=ALN/60

Where,

A=Area of the Cylinder

L=Length of Stroke in m.

N=Speed of Crank in RPM

For Double acting

Q=2ALN/60

16. What is the relation between Work done of a Pump and Area of Indicator Diagram? Work done by the pump is Proportional to the area of the Indicator diagram.

17 .What is the relation betweenWork done of a Pump and Area of Indicator Diagram ?
Work done by the pump is Proportional to the area of the Indicator diagram.

18.. What is the Work done by the Pump per sec due to acceleration and friction in the suction and delivery Pipes ?

For single acting

$W= \rho gALN(hs+hd+0.67hfs+0.67hfd)/60$

For Double acting

$W=2\rho gALN(hs+hd+0.67hfs+0.67hfd)/60$

Where hfs, hfd =loss of head due to acceleration in the suction and delivery Pipe.

19..What is the Mean Velocity of Single acting reciprocating pump ?

$v=A\omega r/3.14a$

Where

ω =Angular velocity in rad/sec r

=Radius of the crank in m

A and a =Area of cylinder and Pipe in m