CE 1253 APPLIED HYDRAULIC ENGINEERING

II – YEAR CIVIL ENGINEERING
FOURTH SEMESTER

(SHORT QUESTION AND ANSWERS)

TWO MARKS
QUESTION AND ANSWERS

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 convert mechanical energy in to hydraulic energy

3.Define sub critical flow:

If the froude number is less than one then the flow is said to be sub critical flow

4.Define critical flow:

If the froude number is less equal to one it is called as critical flow.

5.Define supercritical flow:

If the froude number is greater than one it is called as super critical flow

6. What are the possible types of flow in open channel with respect to space and time?

A,steady and unsteady flow

B,uniform and nonuniform flow

7.what do you know about uniform and non uniform flow?

Uniform flow: If the given length of the channel ,depth ,velocity ,the rate of flow, cross section are constant.

Non Uniform flow: If the given length of the channel ,depth ,velocity ,the rate of flow, cross section are not constant.

8.Define specific energy:

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

9.What is meant by wetted perimeter?

The wetted perimeter (p) is the length of the line of intersection of the channel wetted surface with the cross section plan normal to the direction of flow.

10.Define critical depth:

It is defined as the depth of flow of water at which the specific energy is minimum.

11.Define critical velocity:

The velocity of flow at the critical depth is known as critical velocity

12.Define the term most economical section of the channel:

A section of the channel is said to be most economical when the cost of construction of the channel is minimum. But the cost of construction depend up on the excavation and lining to keep the cost minimum The wetted perimeter for a given discharge should be minimum.

13.Define gradually varying flow

If the change in depth in a varying flow is gradual so that the curvature of the streaming line is not excessive such flow is called gradually varying flow.

14.Define Rapidly varying flow

If the curvature in a varied flow is large and depth changes appreciably over short length it is called rapidly varying flow.

15.Define affux

The maximum increase in water level due to obstruction in the path of flow is known as affux.

15.Define length of backwater curve

The distance along the bed of the channel between the section where water starts raising to the section where water is having maximum height is known as the length of the back water curve

16.Define back water

The profile of the raising water on the upstream side of the dam is called as back water curve.

17.Define hydraulic jump

The raise of water level which takes place due to the transformation of the unstable shooting flow (super critical flow) to the stable Streaming flow (sub critical flow) is called hydraulic jump.

18.Define cavitations

cavitations is defined as phenomenon of formation of vapour bubbles in a region of a flowing liquid where the pressure in the liquid is falls below than vapour pressure and sudden collapsing of these vapour bubbles in a region of higher pressure.

19.What is known by governing of a turbine?

Governing of a turbine is defined as the operation by which the speed of the turbine is kept constant under all conditions of working . It is done by oilpressure generator.

20.Explain gross head

The difference between head race level and tail race level when no water is flowing is know as gross head

21.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

$$H=Hg-Hf$$

22.Define Hydraulic Efficiency:

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

23.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.

24.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.

25.Define over all efficiency

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

26.Explain impulse turbine

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

27.Explain Reaction turbine

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

28.Explian tangential flow turbine

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

29.Expain radial flow turbine

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

30.Explain inward flow radial turbine

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

31.Explain outward flow radial turbine

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

32.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.

33.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.

34.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.

35.What is jet ratio?

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

36.What is Draft tube?

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

37.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.

38.what is radial discharge?

This means the angle made by absolute velocity with the tangent on the wheel is 90 and the component of whirl velocity is zero.

39.Define Francis turbine:

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

40.Define propeller turbine:

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

41.Define Kaplan turbine:

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

42.What are the use 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 usefull pressure energy

43.What are types of draft tube?

1.conical draft tube

2.simple elbow tube

3.moody spreading tube

3.draft tube with circular inlet and rectangular outlet.

44.What are the types of characteristic curves

1.Main characteristic curves

2.Operating characteristic curve

3.Muschel characteristic curves

45.What is specific speed of the turbine?

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

46.Define unit quantities;

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

47.Explain about characteristic curves of a hydraulic turbine

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

48.What is meant by conveyance of the channel?

The conveyance of the channel is denoted by k and is given by $k=AC\sqrt{(m)}$.

49.Define the term most economical section:

A section of the channel is said to be most economical when the cost of construction of the channel is minimum. But the cost of construction mainly depend up on the excavation and lining to keep the cost minimum ,the wetted perimeter for a given discharge should be minimum.

50.What are the conditions of rectangular channel of best section?

The two conditions are breadth is equal to two times the depth (b=2d) and hydraulic mean depth is equal to half the depth (m=d/2)

51.Write down the conditions for the most economical trapezoidal channel?

1.Half the top width is equal to one of sloping side $(b+2nd)/2=d\sqrt{(1+n^2)}$

2.Hydraulic mean depth is equal to half the depth.

52.Write down the conditions of most economical circular channel with maximum velocity?

$\theta=128°45'$

$d=0.81D$

$m=0.3D$

53.What do you mean by open channel flow?

1.Open channel flow has a free surface which is subjected to atmospheric pressure.

2.In open channel flow the cross section is irregular.

54.What do you mean by pipe flow?

1.Pipe flow has no free surface and subjected to hydraulic pressure only.

2.The cross section of the flow is fixed

55.List the instrument used to measure open channel flow

1.pitot tube

2.ultrasonic flow instrument.

3.Dropper instrument

4.Gurley instrument.

56.What is the best side slope for trapezoidal channel ?

$\theta=60°$ is the best side slope for trapezoidal channel.

57.what do mean by M_1 profile?

The most common of all gradually varying flow is of M_1 type which is a sub critical flow condition obstructions to flow such as wiers, dams etc…which produce M_1 profile.

58.What are the types of flow profile?

Mild slope profile

Steep slope profile

Critical slope profile

Horizontal bed profile

Adverse slope profile

59.What do you mean by M_2 profile?

The M2 profile occurs at a sudden drop in the bed of the channel in to the ponds or pools or lakes.

60.What do mean by M_3 profile?

The M_3 profile occurs the flow yielding from a spillway or a sluice gate.

61.What is speed ratio?

$U_1=\phi\sqrt{(2gH)}$

Where U_1 – tangential velocity of wheel at inlet

ϕ -speed ratio

H – Head of the turbine.

62.What do you mean by coefficient of velocity?

$V_1=C_v\,(2gH)$

V_1 = velocity of jet

C_v = coefficient of velocity

H = head of the turbine.

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

1. nozzle and flow regulating arrangement
2. runner with buckets
3. casing
4. breaking jet

64.What are the main mechanism of Radial flow reaction turbine?

1.casing

2.guide mechanism

3.runner

4.draft tube

65.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.

66.Define Manometric head:

Manometric head is the head against which a centrifugal pump has to work.

$$H_m = H_s + h_d + H_{fs} + H_{fd} + (vd^2/2g)$$

Where H_m – manometric head

H_s - suction head

H_d – delivery head

H_{fs} – friction head loss in suction pipe

H_{fd} – friction head loss in delivery pipe

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

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

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

Slip is defined as the difference between theoretical discharge and actual discharge.

If actual discharge is greater than theoretical discharge negative value is found this negative value is called negative slip.

69.What do you know coefficient of discharge?

It is defined as the ratio of actual discharge by theoretical discharge. It is denoted By C_d .

70.What do you know Drop down curve?

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

71.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 exit which means separation of liquid takes place. The pressure at which separation takes place is called separation pressure and head corresponding to the separation pressure is called separation pressure head.

72.What is an indicator diagram?

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

73.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.

74.What are the assumptions of gradually varying flow profile?

1.Pressure distribution at any section is assumed to be hydrostatic.
2.The velocity distribution at the channel section is fixed
3.The channel is prismatic
4.The roughness coefficient is independent of the depth of flow.

75.What the two cases where distance of the normal depth of flow does not exit?

(a) When the channel bed is horizontal
(b) When the channel bed has a adverse slope.

76.What are the methods used for finding gradually varying flow profile?

1.Direct integration method
2.Numerical method
3.Graphical representation method.

77.What are the classification of hydraulic turbine according to the type of energy at inlet ?

(a) Impulse turbine and
(b) Reaction turbine

78.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

79.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

80.What are the types of turbine according to the specific speed of the turbine?

(a) Low specific speed turbine
(b) Medium specific speed turbine
(c) High specific speed turbine.

81.Write down the expression for energy loss due to hydraulic jump?

$H_L = (d_2-d_1)^3 / (4d_1d_2)$

Where

H_L – energy loss due to hydraulic jump
D_2 - depth of flow after the jump
D_1 -- depth of flow before the jump

82.What do you mean by length of hydraulic jump?

This is defined as the length between the two sections where one section is taken before the hydraulic jump and the second section is taken immediately after the jump.

83.What are the classification of flow in channels?

1.steady flow and un steady flow.
2.uniform flow and non uniform flow.
3.Laminar flow and turbulent flow and
4.sub critical , critical and super critical flow.

84.What are the types of Non uniform flow?

(i) Rapidly Varied Flow (R.V.F)
(ii) Gradually Varied Flow (G.V.F)

85.What do you know about laminar and turbulent flow?

Laminar flow:

The flow in open channel is said to be laminar if the Reynolds number(R_e) is less than 500

Turbulent flow:

If the Reynolds number is greater than 2000 it is called turbulent flow.

86.What do you mean by specific energy curve?

It is defined as the curve which shows the variation of specific energy with respect to depth of flow.

87.Write the manometric efficiency of the pump?

Manometric efficiency $= (gHm)/(V_{w2}U_2)$

Where

Hm –manometric head

88.Write the expression for over all efficiency ?

over all efficiency = $(\vartheta g\ QHm)/(1000 \times P)$

Where

Hm – manometric head

P - power

89.What is the minimum speed for starting the centrifugal pump?

$N=(120\ \eta_{man} V_{w2}\ D)/(\pi(D_2^2-D_1^2)$

Where

η_{man} – manometric efficiency

V_{w2} _- Whirl at out let of the turbine

D_2 - diameter of impeller at out let

.

90. 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

91.Define open channel flow?

The term *open channel flow* denotes the gravity-driven flow of a liquid with a free surface.

92.What do you mean by stream lining?

'Streamlining is adding a faired tail section to reduce the extent of separated flow on the downstream portion of an object .

93.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.

94.What do you know about Hub or Boss?

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

95.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.

96.What are the uses of Kaplan turbine?

1.To produce more out put.

2.The efficiency of the turbine is more

97.Define unit speed:

It is defined as the speed of the turbine under unit head

$N_u = N/\sqrt{H}$

Where

N_u –unit speed

N –number of rotations

H- head of the turbine

98.Define unit discharge

It is defined as the discharge passing through the turbine which is working under unit head.

$Qu = Q/\sqrt{H}$

Where Qu – unit discharge

Q – Total discharge

H- head of the turbine

99.Define unit power:

It is defined as the power developed by the turbine working under unit head.

$Pu = P/H^{3/2}$

Where Pu - unit power.

P - Total power.

H- head of the turbine.

100.What are the main parts of centrifugal pump?

1.Suction pipe with foot valve and strainer

2.Impeller

3.casing

4.delivery pipe

101.What are fluid machines?

The machines which use the liquid or gas for the transfer of energy from fluid to rotor or from rotor to fluid, are known as fluid machines.

102. What are hydraulic machines and thermal turbo machines?

If liquid is used for the transfer of energy, then machines are known as hydraulic machines whereas if gas is used then machnes are known as thermal turbo machines.

103.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..

104.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.

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

Work saved by fitting air vessels in a single acting pump is 84.87%,

In a double acting pump the work saved is 39.2%.

106.What is Discharge through a Reciprocating Pump in Per sec ?

For Single acting

Discharge (Q)=ALN/60

Where

A=Area of the Cylinder in m^2
L=Length of Stroke in m.
N=Speed of Crank in RPM

For Double acting

Q=2ALN/60

107. What is the Workdone by Reciprocating Pump Per sec.?

Workdone = $\rho gALN(h_s+h_d)/60$ (for single acting)

For Double acting:

Work done= $2\rho gALN(h_s+h_d)/60$

Where

ρ=Density of Water in kg/m^3
A=Area of the Cylinder in m^2
L=Length of Stroke in m
N=Speed in rpm
h_s,h_d=Suction and Delivery head in m

108. What is the Pressure head due to acceleration in the Suction & Delivery Pipe ?

$$h_f = 4fl(A/a * \omega r \sin\theta)^2/2gd$$

where

f=Co-efficient of friction. A = Area of piston in m^2. a = Area of pipe in m^2.

ω = Angular speed r = Radius of crank

109. 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.

110.. 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.

111.. 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^2

16 MARKS

1.Write the classification of flow and explain it?
2.A trapezoidal channel with a side slope of 1:1 has to designed to carry 10 cubic meter /sec at the velocity of 2m/sec . so that the amount of concrete lining for the bed and to the side is minimum .calculate the area of lining for 1m length.
3.A rectangular channel has a width of 2m and carries a discharge of 4.8 cubic meter/sec with a depth of 1.6 m .At a certain section a small hump with a flat top and of height 0.1m is proposed to be built. Calculate the likely change in water surface neglect the energy loss.
4.Design a earthen channel with velocity of flow 1m/s and discharge 2 m3/s having side slope 2H to 1V for the most economical section take C as 55.
5.Find the discharge through a circular pipe of diameter 3m if the depth of water in the pipe is 1m and the pipe is laid at a slope of 1 in 1000 .Take the value C =70.
6.Derive the most economical section for discharge:
7. Derive the most economical section for velocity:
8.Draw the specific curve , regimes of flow and explain it :
9.For a constant specific energy of 1.8 m calculate the maximum discharge that may occur in a rectangular channel of 5m wide.
10.Water flows at the rate of 16 cumec in a channel 10 m wide at a velocity of 1.6 m/sec. Calculate the specific energy head . Find also the critical depth, Critical velocity ,and the minimum value of specific energy head corresponding to this discharge in the channel.
11.Expain and derive the channel with a hump with a neat sketch:
12.A trapezoidal channel has to be excavated through hard clay at least cost . Determine the dimension of the channel the discharge is equal to 10 cumec and bed slope as 1 in 5000 and mannings N= 0.012 side slope 3Hto 2V.
13.Expain the classification of flow profile?
14.A trapezoidal channel has a wet width of 4m and bed slope 0.0004 and side slope 1H to 2V and roughness coefficient 0.02 the normal depth of flow is 2m and critical depth is 0.69 m. Calculate the gradually varying flow profile up to a depth of 2m by direct step method.
15.Explain Pelton wheel turbine with neat sketch?
16.Expalin radial flow turbine with neat sketch.?
17.A pelton wheel is to be designed for a head of 60m when running at 200 rpm .The pelton wheel develops 95.6475 KW shaft power .The velocity of buckets is 0.45 times the velocity of jet, Over all efficiency is 0.85 and co efficient of velocity is equal to 0.98.
18.Determine the length of backwater curve caused by an affux of 2m in a rectangular channel of width 40 m and depth 2.5m .The side slope of the bed is given as 1 in 11000 take N=0.03.
19.Explain in detail about backwater curve with neat sketch?
20.Explain about direct step method and graphical method with an example?
21.Expalin indicator diagram and air vessels ?
22.Explain about centrifugal pump with neat sketch?
23.Explian about single acting reciprocating pump and double acting reciprocating pump with neat sketch?

24.A centrifugal pump has the following dimensions inlet radius = 80mm, outlet radius =160mm, $\beta 1$ = 0.45 radians and $\beta 2$ =0.25 radians N =90 rad/sec .
Determine (i) Discharge
(ii) Head developed

25.The cylinder bore diameter of a single acting reciprocating pump is 150 mm and its stroke is 300mm .The pump runs at 50 rpm and lifts water through a height of 25 m .The delivery pipe is 22 m long and 100 mm in diameter .Find the theoretical discharge and the theoretical power required to run the pump . If the actual discharge is 4.2 lit/sec .Find the percentage slip . Also determine the acceleration head at the beginning and middle of the delivery stroke.