SUMMER – 14 EXAMINATION

Subject Code: **17411** **Model Answer**

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. 1 a)

i) Specific weight is defines as ratio between the weights of a fluid to its volume. w= ρg.
Unit of specific weight is N/m^3

01 mark

Specific gravity- is define as ratio of the specific weight of a fluid to the specific weight of a standard fluid. For liquids standard fluid is taken as water and for gases the standard fluid is taken as air. **01 mark**

ii) Total pressure is define as the force exerted by a static fluid on as surface either plane or curved when the fluid comes in contact with the surfaces .Force always acts normal to the surface. **01 mark**

Centre of pressure is defined as the point of application of the total pressure on the surface.

01 mark

iii) Steady flow : The type of flow in which the fluid characteristics like velocity, pressure , density etc at a point do not change with time. **01 mark**

Uniform Flow: The type of flow in which velocity at any given time does not change with respect to space. **01 mark**

iv) Force exerted by jet of water on moving vertical plate

$F = \rho a (V- u)^2$

(ρ) = density of fluid a= area of cross section of the jet

V= velocity of the jet u =Velocity of the flat plate **01 mark**

Work done WD = F x u = $pa (V- u)^2$ x u **01 mark**

v) Continuity equation:

Based on the principle of conservation of mass a fluid flowing through the pipe at all cross section the quantity of fluid per second is constant. **01 mark**

Equation $\rho_1 A_1V_1=\rho_2A_2V_2=\rho_3A_3V_3$

$A_1V_1=A_2V_2= A_3V_3$ **01 mark**

vi) Negative slip :

- The difference of theoretical discharge and actual discharge. If actual discharge is more than the theoretical discharge the slip of the pump will become negative.
- Occurs when delivery pipe is short, suction pipe is long ,pump is running at high speed.

vii) Classification of Hydraulic turbines(any two)

- According to the type of energy at inlet- Impulse turbine and Reaction turbine
- According to the direction of flow through runner- Tangent flow turbine, Radial flow turbine, Axial flow turbine and mixed flow turbine
- According to the head at the inlet of the turbine- High head , medium head and low head
- According to specific speed of the turbine- Low specific speed , Medium specific speed and High specific speed turbine

01 Mark each type

viii) Types of impellers:

Fully closed type (closed or shrouded)
Semi closed type
Open type **01 mark**

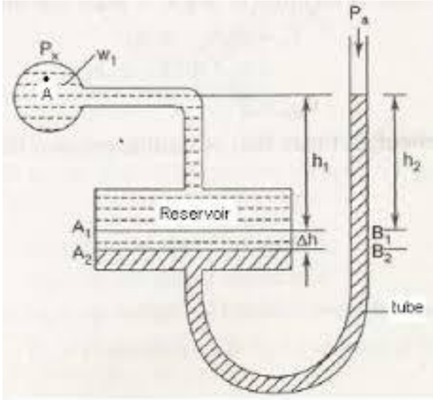
Type of casings :

Volute casing

Vortex casing

Casing with guide blades **01 mark**

B) a) Single column manometer



Description:

- Modification form of U tube manometer in which a reservoir, having a large cross-section area (100 times) as compared to area of the tube is connected to one of the limbs of the manometer.
- Due to large cross section area of the reservoir, for any variation in pressure, the change in liquid level in the reservoir will be very small which may be neglected and the pressure is given by the height of the liquid in the limb.
- Types: Vertical single column manometer & inclined single column manometer.

(**Sketch 2 M Description 2 M.)**

b) Atmospheric pressure: The pressure which is exerted due to the weight of air above earth's surface. **01 mark**

Gauge pressure: The pressure which is measured with help of a pressure measuring instrument in which the atmospheric pressure is taken as datum. **01 mark**

Absolute pressure: The pressure which is measured with reference to absolute vacuum pressure **01 mark**

Relation: Absolute pressure = Atmospheric pressure + Gauge pressure **01 mark**

c) Equation of power transmission by fluid in pipe (P)

$$P = (\rho .\ g.\ A .V) \times (H - 4f\ L\ V^2 / 2.g .d)$$

ρ = Density of fluid A=Cross sectional area of pipe

V= velocity of flow in pipe d= diameter of the pipe

H= total head available at the inlet of pipe f = coefficient of friction of pipe

L = Length of the pipe

(01 mark forequation 01 mark for notations)

Condition for maximum Power transmission

$\frac{d}{dV}$(P) =0

$\frac{d}{dV}$ [(ρ. g. A .V) x (H- 4f L V^3 / 2.g .d)] =0

[(ρ. g. A) x (H- 4 x 3 . f . L . V^2 / 2.g .d)]= 0

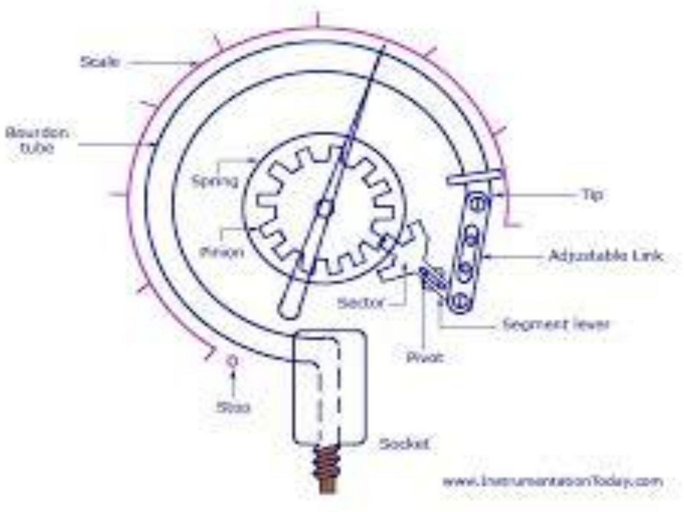
H- 3 x 4 . f. L. V^2 / 2.g .d= 0

H- 3 hf = 0 * $hf = \frac{4\,f\,l\,v2}{2gd}$

hf= H /3 **02 marks**

The power transmitted through a pipe is maximum when the loss of head due to friction is one-third of the total head at inlet.

Q 2 a) Bourden Pressure gauge



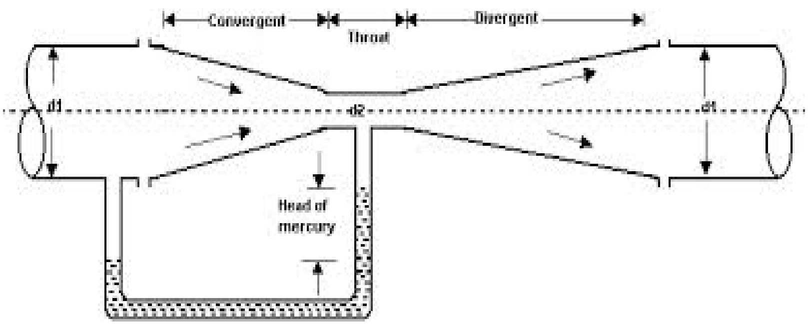
Bourdon Tube Pressure Gauge

Working:

- The gauge pressure is usually measured by a bourdon pressure gauge because of its robust and simple construction.
- The bourdon type is a hollow metal tube of elliptical cross-section and bend form of a circle. one end of bourdon tube is fixed to frame whereas the other end free to move.
- The free end actuates pointer through a suitable linkage. As pressure inside the tube increases, the elliptical cross –section tends to become circular and the free end of the tube moves outward. In this way pointer shows the pressure value on the scale.

(**Sketch 2 M ,Description 2 M.)**

b) Derive equation of actual discharge through venturimeter



Q-2 (b)

Consider a Venturimeter fitted in a horizontal pipe through which fluid is flowing

d_1 = diameter at inlet or at section (1)

P_1 = pressure at section (1)

V_1 = Velocity of fluid at section (1)

$a_1 = \frac{\pi}{4} d_1^2$ = area at section (1)

d_2, P_2, V_2, a_2 are Corresponding values at section (2)

Applying Bernoulli's equation at section (1) & (2)

$$\frac{P_1}{\omega} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\omega} + \frac{V_2^2}{2g} + Z_2$$

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} \quad (Z_1 = Z_2 \text{ Pipe is horizontal})$$

$$\therefore \frac{P_1 - P_2}{\rho g} = \frac{V_2^2}{2g} - \frac{V_1^2}{2g}$$ 01 Mark

$\therefore \frac{P_1 - P_2}{\rho g}$ is the difference of pressure heads $\therefore \frac{P_1 - P_2}{\rho g} = h$

$$h = \frac{V_2^2}{2g} - \frac{V_1^2}{2g}$$

Applying continuity equation at section (1) & (2)

$$a_1 V_1 = a_2 V_2 \quad \therefore V_1 = \frac{a_2 V_2}{a_1}$$ 01 Mark

$$h = \frac{V_2^2}{2g} - \frac{\left(\frac{a_2 V_2}{a_1}\right)^2}{2g} = \frac{V_2^2}{2g}\left[\frac{a_1^2 - a_2^2}{a_1^2}\right]$$

$$V_2^2 = 2gh \frac{a_1^2}{a_1^2 - a_2^2}$$

$$V_2 = \sqrt{2gh}\, \frac{a_1}{\sqrt{a_1^2 - a_2^2}}$$ 01 Mark

Discharge $Q = a_2 V_2 = a_2 \frac{a_1}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$

$$Q_{theo} = \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$

Q_{act} will be less than theoretical discharge

$$\therefore Q_{act} = C_d \times \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$ 01 Mark

c) Given data

d=0.075m v= 25 m/s a= $\frac{\pi}{4}(0.75)^2 = 0.004417\ m^2$

Angle between jet and plate =60^o

i) Force exerted by the jet of water in the direction normal to plate

$Fn = \rho a\,(V-u)^2 \sin\theta = 1000 \times 0.004417 \times (25)^2 \times \sin 60$ = **2390.7 N** **02 marks**

ii) Force exerted by the jet of water in the direction of jet

$Fx = \rho a V^2 \sin^2\theta = 1000 \times 0.004417 \times 25^2 \times \sin^2 60$ = **2070.4 N** **02 marks**

d) Given data

d= 200 mm =0.2m L= 500 m hf = 4 m of water f= 0.009

$hf = \frac{4\,f\,l\,v2}{2gd}$

$4 = 4 \times 0.009 \times 500 \times V^2 / 0.2 \times 2 \times 9.81$

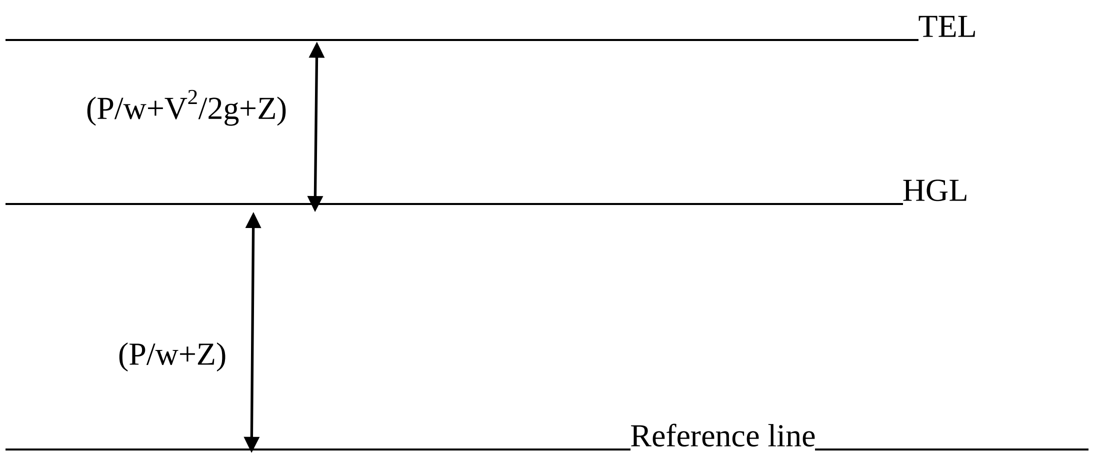
V= 0.934m/s **02 marks**

Q =Velocity x Area = $0.934 \times \frac{\pi}{4}(d)^2 = 0.934 \times \frac{\pi}{4}(0.2)^2$

Q = $0.0293\ m^3$/sec =29.3 litres/sec **02 marks**

e) Hydraulic gradient line 0(HGL) : Tt is defined as the line which gives the sum of pressure head (p/w) and datum head (z) of a flowing fluid in a pipe with respect to some reference line. It showing the pressure head of a flowing fluid in a pipe from the centre of the pipe.

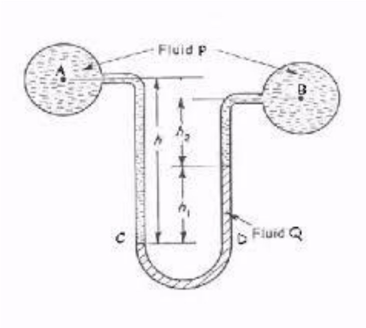
Total Energy Line (TEL) :It is defined as the line which gives the sum of pressure head (p/w) ,kinetic head and datum head (z) of a flowing fluid in a pipe with respect to some reference line.It obtained by joining the tops of all vertical ordinates showing sum of pressure head, kinetic head and datum head (z) from centre of the pipe.



(**Description 3 M Sketch 1M.)**

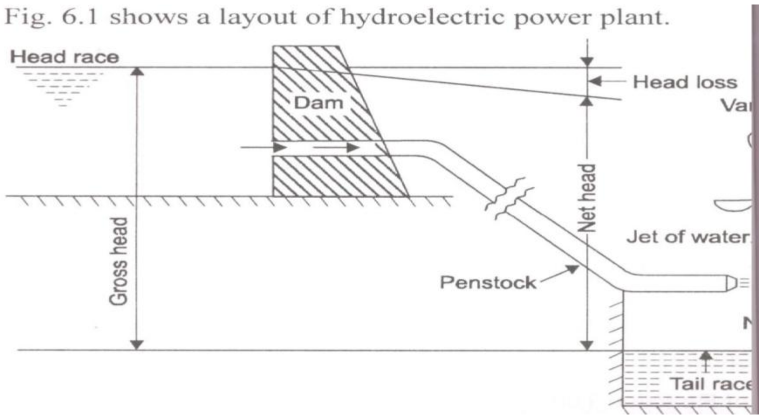
f) Simple differential manometer :It is used for measuring the difference of pressure between two points in a pipe or in two different pipes.It consist of a U tube, containing a heavy liquid , whose two ends are connected to the points, whose difference of pressure is to be measured.

Types U tube differential manometer & Inverted U tube differential manometer



(**Description 3 M Sketch 1M.)**

Q 3 a) Layout of hydraulic power plant



The general layout of a hydraulic power plant consist of :

Dam- constructed across a river to store water.

Penstock – Pipes of a large diameters called penstocks which carry water under pressure from the storage reservoir to the turbines of pipe)

Turbine- different types of vanes fitted to the wheels.

Tail race – a channel which carries water away from the turbine after the water has worked on the turbines. (**Description 2 M Sketch 2M.)**

b) Given data - Pelton wheel

D = 1 m N= 1000 rpm H =700m φ = 15° Q =0.1 m^3/s

Tangential velocity of the wheel u =π DN /60 = π x 1 x 1000/ 60 = **52.36 m/s**

Velocity of the jet at inlet V_1= Cv $\sqrt{2\, g\, H}$ = 1 x $\sqrt{2 \times 9.81 \times 700}$ = **117.19 m/s 01 marks**

***The value of Cv is not given Take as 1**

i) Power available at the nozzle $= \frac{\rho g Q H}{1000}$ = 1000 x 9.81 x 0.1 x 700 /1000 = **686.7 kw**

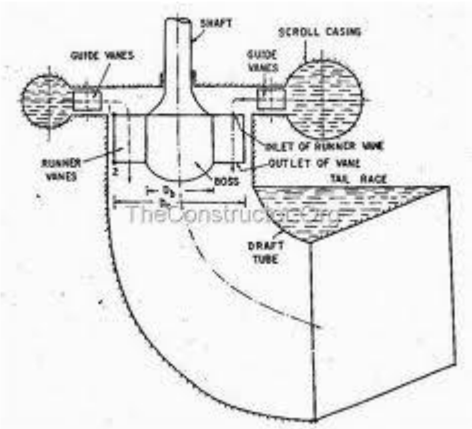
01 mark

ii) Hydraulic efficiency = $\frac{2(V1-u)(1+\cos\varphi)u}{V12}$

= 2 (117.19 – 52.36) (1+ cos15^o) x 52.36 / (117.19)^2

= 0.9718 = 97.18 % **02 marks**

c) Kaplan Turbine



Construction –it is a axial flow reaction turbine. It consist of main parts scroll casing , Guide vanes mechanism, hub with vanes or runner of the turbine and draft tube.

Working: The water from penstock enters the scroll casing and then moves to the guide vanes. From the guide vanes, the water turns through 90 ^{o} and flows axially through the runner .During the flow of water through runner a part of pressure energy is converted into kinetic energy. (**Sketch 1M. Construction 1.5 M Working 1.5 M)**

d) Given data

D =50 mm =0.05 m a= $\frac{\pi}{4}(0.05)^2$ = 0.001963 m^2 V = 40 m/s

Angle of deflection =120

The angle of deflection = 180- θ =180-120 = 60^o **02 marks**

Force exerted by the jet of water on the curved plate in the direction of the jet

Fx = ρa V^2 [1+cosθ]=1000 x0.001963x(40)^2 [1+cos 60^0]**= 4711.15 N** **02 marks**

e)Surface Tension: The tensile force acting on the surface of liquid in contact with a gas or on the surface between two immiscible liquids such that the contact surface behave like membrane under tension. The magnitude of the tensile force per unit length of the free surface. Unit N/m .

02 marks

Capillarity : A phenomenon of rise or fall of a liquid surface in a small tube relative to adjacent general level of liquid when the tube is held vertically in the liquid. It expressed in terms of cm or mm of liquid and it depends upon specific weight of liquid, diameter of tube, surface tension

- The rise of liquid surface : capillary rise
- The fall of the liquid surface : capillary depression **02 marks**

e) Given data

Circular plate d=3 m $A = \frac{\pi}{4} d^2 = 7.0685\ m^2$

Distance DC = 1.5m BE =4 m

Distance of C.G. from free surface = h=CD+ GC sin θ = 1.5+1.5 sinθ

Sinθ = AB /BC= BE- AE / BC = 4-DC/3 =4-1.5/3 =0.833

h= 1.5 + 1.5 x 0.833 = 2.749 m

Total Pressure (F)

F = ρ x g x A x h =1000 x 9.81 x 7.0685 x 2.749 = **190621 N** **02 marks**

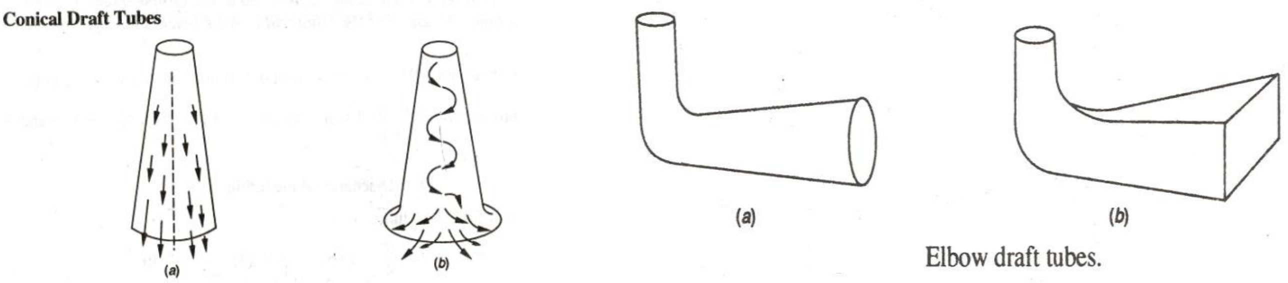
Centre of pressure (h*)

$h^* = \frac{I_G \sin^2\theta}{Ah} + h$ $I_G = \pi / 64.\ d^2 = 3.976\ m^4$

$h^* = \frac{3.976 \times 0.833 \times 0.833}{7.0685 \times 2.749} + 2.749$ **h* = 2.891 m** **02 marks**

4. Attempt any TWO of the following:

a) What is draft tube? State the types of draft tube. Explain any one in detail. (2+2+4)



Draft tube is a pipe which connects the turbine outlet to the tail race through which the water exhausted from the turbine runner flows to the outlet channel. Draft tubes are of two types:

i) Conical: In this draft tube, its diameter increases from outlet of the runner to the channel as shown in fig. Conical draft tubes are commonly used in Francis turbine. For good efficiency, the central flaring angle is kept about 8^o. The other variety is having a bell mounted outlet. It is best suited for inward or outward flow turbines, having helical flow which is due to velocity of whirl at out let of runner. Its efficiency is as large as 90%.

ii) Elbow type: In this draft tube the bend of the tube is generally 90^o and area of the tube gradually increases from the outlet of the runner to the channel as shown in fig. The elbow draft tube s are commonly used in Kaplan turbine. It has circular section at inlet and outlet. the other variety has rectangular section at outlet. The efficiency of elbow draft tube is generally between 60% to 70%.

iii) Moody spreading tube: suitable where conical tube is not able to give sufficient increase in area due to separation problem. It is helpful in reducing whirling action of water coming out from runner end thus reduces eddy losses.

b) A centrifugal pump having outer diameter equal to two times the inner diameter and running.at 1000 rpm works against a total head of 40 m. Velocity of flow through impeller is constant and equal to 2.5m/s. The vanes are set back at an angle at 40o at outlet. If diameter of impeller is 500 mm and
width at outlet is 50 mm. Calculate
i) Discharge
ii) Vane angle at inlet
iii) W.D. by impeller on water per second.
iv) Manometric efficiency.

Given:

Speed, $N = 1000$ rpm

Head, $H_m = 40$ m

Velocity of flow, $V_{f_1} = V_{f_2} = 2.5$ m/s

Vane angle at outlet $\phi = 40°$

Outer dia. of impeller, $D_2 = 500\text{ mm} = 0.5$ m

Inner dia. of impeller, $D_1 = \frac{D_2}{2} = \frac{0.5}{2} = 0.25$ m

Width at outlet, $B_2 = 50\text{ mm} = 0.05$ m

Tangential velocity of impeller at inlet and outlet are

$$u_1 = \frac{\pi D_1 N}{60} = \frac{\pi \times 0.25 \times 1000}{60} = 13.09 \text{ m/s}$$

and $$u_2 = \frac{\pi D_2 N}{60} = \frac{\pi \times 0.5 \times 1000}{60} = 26.18 \text{ m/s}$$

Discharge is given by

$$Q = \pi D_2 B_2 \times V_{f_2}$$
$$= \pi \times 0.5 \times 0.05 \times 2.5$$
$$= 0.1963 \text{ m}^3/\text{s}$$ —— (01 Mark)

i) Vane angle at inlet (θ):

From inlet velocity triangle, $\tan\theta = \frac{V_{f_1}}{u_1}$

$$\therefore \tan\theta = \frac{2.5}{13.09} = 0.191$$

$\therefore \theta = \tan^{-1}(0.191) = 10.81°$ or $10°48'$ – (01 Mark)

Work done by impeller on water per second is given by equation as

$$= \frac{W}{g} \times V_{w_2} u_2 = \frac{\rho \times g \times Q}{g} \times V_{w_2} \times u_2$$

$$= \frac{1000 \times 9.81 \times 0.1963}{9.81} \times V_{w_2} \times 26.18$$

→ (01 Mark)

But from outlet velocity triangle, we have

$$\tan\phi = \frac{V_{f_2}}{u_2 - V_{w_2}} = \frac{2.5}{(26.18 - V_{w_2})}$$ — (01 Mark)

$$\therefore 26.18 - V_{w_2} = \frac{2.5}{\tan\phi} = \frac{2.5}{\tan 40} = 2.979$$

$$\therefore V_{w_2} = 26.18 - 2.979 = 23.2 \text{ m/s}$$ — (01 Mark)

Substituting this value of V_{w_2} in above eqn, we get the work done by impeller as

$$= \frac{1000 \times 9.81 \times 0.1963}{9.81} \times 23.2 \times 26.18$$

$$= 119227.9 \text{ N-m/s}$$ — (01 Mark)

Manometric efficiency (η_{man}):-

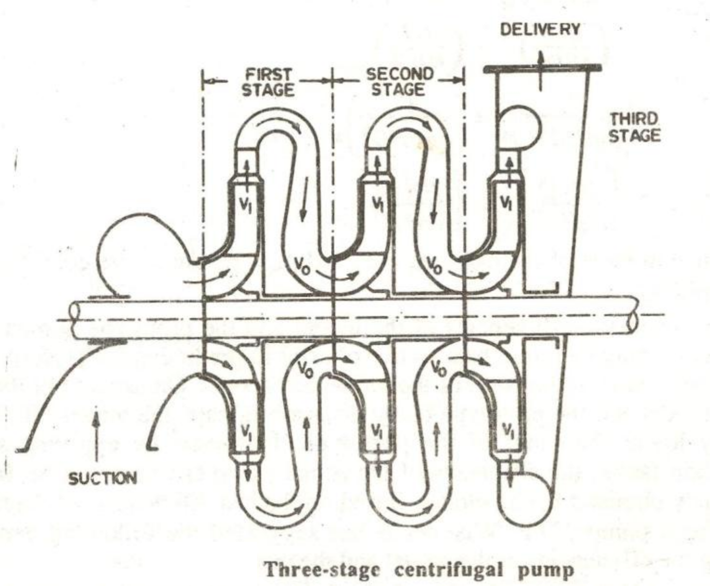
$$\eta_{man} = \frac{gH_m}{V_{w_2} u_2} = \frac{9.81 \times 40}{23.2 \times 26.18}$$

$$= 0.646$$

$$= 64.6 \%$$ — (01 Mark)

(01 Mark for velocity triangles)

c) What is a multistage pump? Explain construction and working of multistage pumps. (2+3+3)



Three-stage centrifugal pump

The centrifugal pump consisting of two or more stages i.e. impeller is called as multistage pump. Multistage pumps are used to produce a high head and/or high discharge. The impellers may be mounted on same shaft or on different shaft.

The head developed by the centrifugal pump is proportional to the diameter and speed of the impeller. Since there is limitation for the diameter and speed of the impeller, therefore head developed by the centrifugal pump is limited to 50 meter or so. For still larger heads it will be necessary to put two or more pumps in series. Liquid from one pump is brought to the inlet of another pump which further increases the head developed. For this two or more impellers can be keyed to same shaft and put into same casing.

5. Attempt any FOUR of the following

a) Define: i) NPSH ii) Manometric efficiency. (2+2)

NPSH: NET POSITIVE SUCTION HEAD is the commercial term used by the pump manufacturers to indicate the suction head which the pump impeller can produce. In other words it can be defined as the net head in meters of liquid required to force the liquid into the pump though suction pipe. Mathematically it is given as the atmospheric pressure head minus vapour pressure head minus frictional head minus velocity head in the suction pipe.

Manometric efficiency: It is the ratio of manometric head to the energy supplied by the impeller/kN of water

b) Define cavitation and separation. (2+2)

Cavitation: When the bubbles of gases formed during separation of flow reach the surface, they burst and exert high dynamic forces on surrounding surface. Due to this metal surface gets eaten away and becomes rough. Thus formation of cavities is called as cavitation.

Separation: Whenever pressure at any point in a flow falls below the vapour pressure of the liquid at that temperature, liquid starts evaporating and dissolved gas starts separating. This phenomenon is called as separation.

c) Explain methods of priming in brief. (2+2)

Manual priming: Water is manually poured through funnel into the casing. Air escapes through the air vent and then air valve is closed. Foot valve does not allow the water to go back to the sump and keeps the suction pipe always filled with water. A separate town supply or reciprocating pump or injector if available can also be used.

Self priming: Pump is fitted with a tank which always keeps some amount of water stored into it for priming the pump for next operation. Various designs are available.

d) Explain Darcy's and Chezy's equation for frictional loses. (2+2)

$$h_f = \frac{4flv^2}{2gd}$$

Darcy's formula
Where h_f is loss of head due to friction, f- coefficient of friction, l – length of pipe v- velocity of water in pipe and d – diameter of pipe

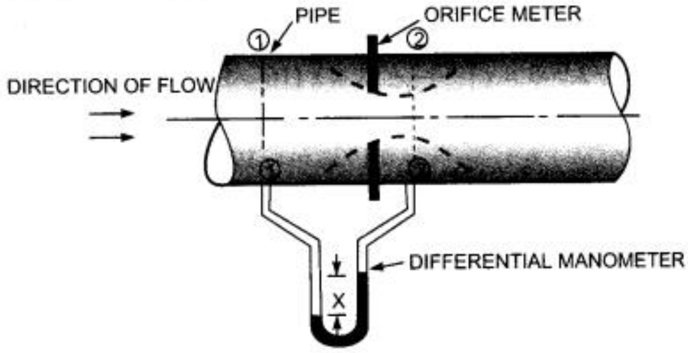
$$v = c\sqrt{mi}$$

Chezy's formula
where v is velocity of water in pipe, m – hydraulic mean depth =A/P = d/4

i – hydraulic gradient i.e. loss of head per unit length = h_f/l, and c - Chezy's constant

e) Explain construction and working of 'Orificemeter' with neat sketch **(02 + 02)**

Let p_1 = pressure at section (1),
v_1 = velocity at section (1),
a_1 = area of pipe at section (1), and



Orifice meter.

It is a device used for measuring the rate of flow of a fluid through a pipe. It is a cheaper device as compare to venturimeter. It also works on the same principle as that of venturimeter. It consists of a flat circular plate which has a circular sharp edged hole called as orifice, which is concentric with the pipe. The orifice dia. is generally kept 0.5 times the dia. of the pipe though it may vary from 0.4 to 0.8 times the pipe dia. A Differential manometer is connected at section 1 which is at a distance of about 1.5 to 2.0 times the pipe diameter upstream from the orifice plate and at section 2 which is at a distance of about half the diameter of orifice on the downstream side from the orifice plate. From this device, the co-efficient of discharge for orifice meter can be found from

$$Q = \frac{C_d\, a_0 a_1 \sqrt{2gh}}{\sqrt{a_1^2 - a_0^2}}$$

where a_1 is area of pipe and a_0 is area of orifice.

f) Explain laws of fluid friction. **(Stating laws 4 M)**

Laws of fluid friction for laminar flow.

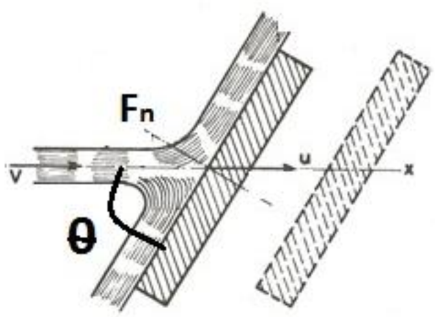
- Frictional resistance is proportional to velocity of flow.
- Frictional resistance is independent of pressure.
- Frictional resistance is proportional to surface area of contact.
- Frictional resistance varies considerably with temperature.
- Frictional resistance is independent of nature of surface of contact.

Laws of fluid frictional for turbulent flow.

- Frictional resistance is proportional to square of velocity of flow.
- Frictional resistance is independent of pressure.
- Frictional resistance is proportional to density of fluid.
- Frictional resistance slightly varies with temperature.
- Frictional resistance is proportional to surface area of contact.

6. Attempt any TWO of the following:

a) i) Derive the equation of force exerted by jet on inclined moving plate in direction of jet. (2+2)



Let flat plate be inclined at an angle θ to the horizontal jet
V be velocity of jet and let the plate move in the direction of jet with velocity u m/sec. F_n is the force normal to plate

so. $F_n = \rho a\,(v-u)\,[(v-u)\sin\theta - 0]$

$= \rho a\,(v-u)^2 \sin\theta$

(Note: Max marks may be given for stating Detailed derivation)

ii) Differentiate between Francis and Kaplan turbine. (any 4 points) (4)

Francis	Kaplan
1. Radial or mixed flow turbine.	1. Axial flow turbine.
2. Medium head 60-300 m.	2. Low head < 60 m
3. Medium specific speed	3. High specific speed
4. Runner vanes are fixed	4. Runner vanes are adjustable
5. More no. of runner vanes	5. Less no. of blades
6. Low part load efficiency	6. High part load efficiency

b) An oil of specific gravity 0.8 is flowing through venturimeter having inlet diameter 20 cm and throat diameter 10cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate discharge of oil through the horizontal venturimeter. Take Co : 0.98.

Given data: i) S_0 = 0.8 ii) S_h = 13.6 iii) Reading of differential manometer = 25 cm

- Difference of pressure head = $h = x\{ S_h / S_0 - 1\}$

  $= 25\{13.6/0.8 - 1\} = 400$ cm of oil. ---------------------4 marks

- Area at inlet (a_1) = 314.16 cm^2

  Area at throat (a_2) = 78.54 cm^2

- Discharge $Q = c_d * a_1 a_2/(a_1^2 - a_2^2)^{1/2} * (2gh)^{1/2}$

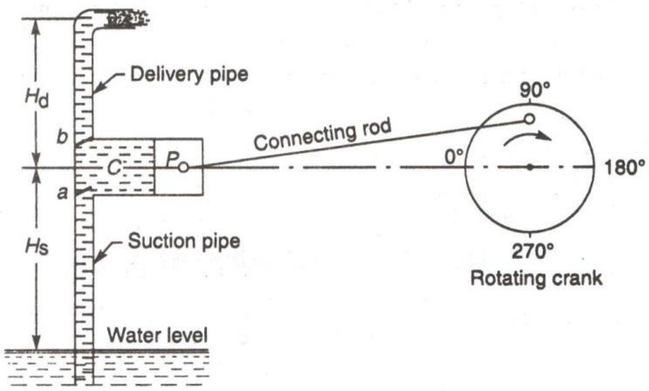
$= 0.98 * 314.16 * 78.54/(98696-6168)^{1/2} * (2*981*400)^{1/2}$

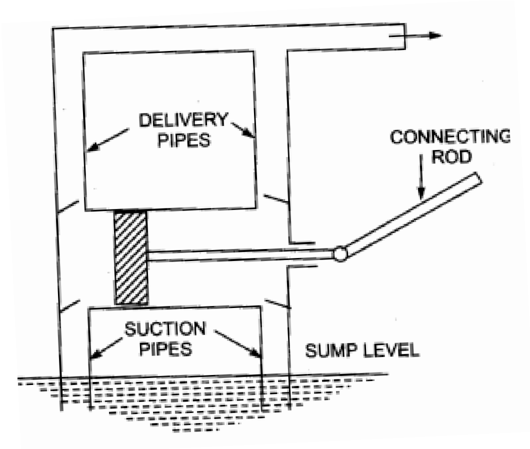
$= 70465\ cm^3/sec$

= 70.465 lit/sec ---------------------4 marks

c) Explain construction and working of single acting and double acting reciprocating pump in brief with neat sketch.

(2+2+2+2)





Working of double acting reciprocating pump:

Reciprocating pump consists of a piston which moves forward & backward in a close fitting cylinder. The movement of the piston is obtained by connecting the piston rod to the crank by means of a connecting rod. The crank is rotated by electric motor/ engine. The one way suction & delivery valves are connected to suction & delivery pipes which are connected to the cylinder as shown in figure. Suction valve allows water from suction pipe to cylinder and delivery valve allows water from cylinder to delivery pipe only.

In single acting pump when crank starts rotating, piston moves towards right thus creating vacuum in the cylinder. This vacuum causes suction valve to open and water enters the cylinder. During the delivery stroke piston, piston moves towards the left thus increasing pressure in the cylinder. This increase in pressure causes the suction valve to close and delivery valve to open and water is forced to delivery pipe.

In double acting pump when crank starts rotating, the water is acting on both sides of the piston. When there is a suction stroke on one of the piston, there is at the same time a delivery stroke on the other side of the piston. Thus, for one complete revolution of the crank, there are two delivery strokes and water is delivered to pipe by the pump during these two delivery strokes.