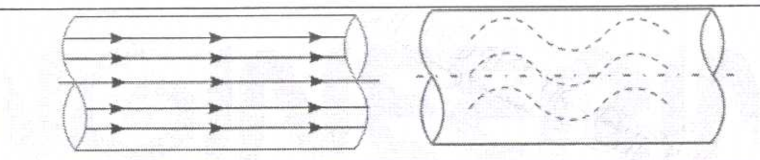
Version B

Scoring Indicators

COURSENAME: Fluid Mechanics & Hydraulic Machinery

COURSECODE: 4022 **QID: 2103230216**

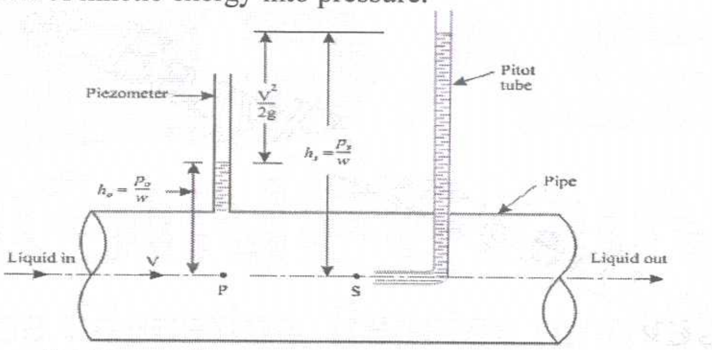
Q N N O	Scoring Indicators	Split Score	Sub Total	Total Score
	PART A			9
1	Weight density or Specific weight	1	1	
2	1000 Kg/m^3	1	1	
3	Poise	1	1	
4	Rate of flow or Discharge	1	1	
5	Reaction	1	1	
6	Francis	1	1	
7	Pelton	1	1	
8	Mechanical	1	1	
9	Parallel	1	1	
	PART B			24
1	Specific gravity is defined as the ratio of specific weight of a liquid to the specific weight of standard fluid. It is usually denoted by S. Specific weight=Specific weight of fluid/ Specific weight of water	3	3	
2	Pascal's law states that "The intensity of pressure at any point in a liquid at rest is the same in all directions".	3	3	
3	 **Fig. 5.5.** Laminar flow. **Fig. 5.6.** Turbulent flow. Laminar flow:- A laminar flow is one in which paths taken by the individual particles do not cross one another and move along well defined paths . This type of flow is also called stream-line flow or viscous flow. Turbulent flow:- A turbulent flow is that flow in which fluid particles move in a zig zag way	1.5 1.5	3	
4	1. Bernoulli's equation ideally applies to fluids with zero viscosity	3	3	

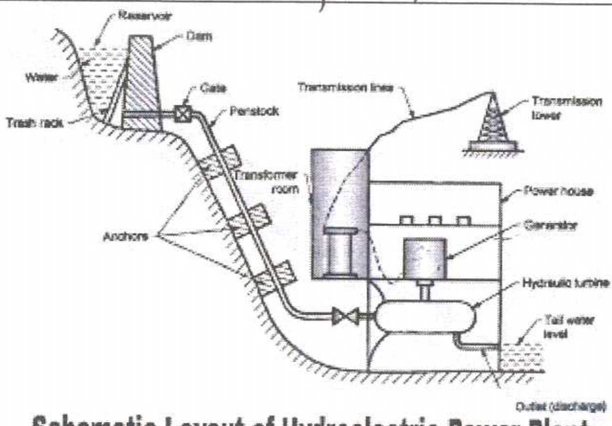
<table>
<tr><td></td><td>or non-viscous fluids.

2. Two external forces except the gravity act on the liquid is non practical. There is always some external forces acts on fluid flow.

3. Bernoulli's equation is applicable only to streamline flow of a fluid this is not valid for non-steady or turbulent flow.

4. The fluids must be incompressible, as the elastic energy of the fluid is also not taken into consideration which is not the case since most common liquids such as water are nearly incompressible.

5.It does not consider centrifugal force for a liquid flowing in a curved path. (Any three)</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>Pitot tube is one of the most accurate devices for velocity measurement. It works on the principle that if the velocity of flow at a point becomes zero, the pressure there is increased due to conversion of kinetic energy into pressure.


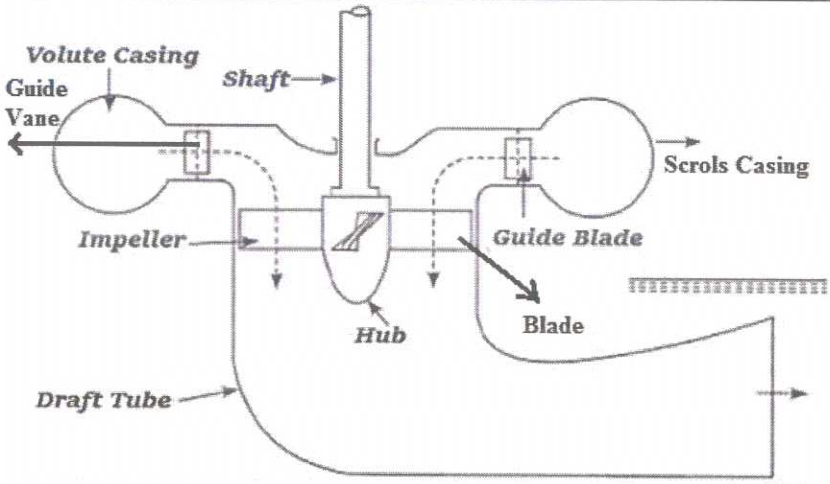
$V = C\sqrt{2g\Delta h}$ figure – 1.5 marks
Explanation – 1.5 marks.</td><td>3</td><td>3</td><td></td></tr>
<tr><td>6</td><td>

Schematic Layout of Hydroelectric Power Plant</td><td>3</td><td>3</td><td></td></tr>
</table>

7	1.Impeller 2.Casing 3.Suction pipe 4.Delivery pipe 5.Footvalve with strainer	3	3	
8	The difference between the theoretical discharge and actual discharge is called the slip of the pump. Slip = $Q_{th.} - Q_{act.}$ percentage of slip , % Slip $= \frac{Qth.- Qact}{Qth} \times 100$	 1.5 1.5	3	
9	Cavitation is defined as the phenomenon of formation of vapour bubbles of a flowing liquid in a region where the liquid falls below its vapour pressure and the sudden collapsing of these vapour bubbles in a region of higher pressure. When the vapour bubble collapse, a very high pressure is created. The metallic surfaces, above which these vapour bubbles collapse, is subjected to these high pressures, which cause pitting action on the surface. Thus cavities are formed on the metallic surface and also considerable noise and vibrations are produced.	3	3	
10	N = 120 r.p.m.; D = 200 mm = 0.2 m; L = 300 mm = 0.3 m; h_s = 4 m; h_d = 20 m; Q = ALN/60 $= \frac{(\pi/4) \times 0.2 \times 0.2 \times 0.3 \times 120}{60}$ =0.0188m^3/s Power required to drive the pump,P = wQ(hs+hd) =9810×0.0188×(4+20)=4426.27 W	1.5 1.5	3	
	Part C			42
1	Volume of the liquid = 1 litre= 0.001 m^3 Specific gravity, s = 0.7 Density of petrol , ρ= Specific gravity × Density of water =0.7 × 1000 = 700 Kg/m^3 Specific Weight,w = ρ × g =700× 9.81= 6867 N/m^3	1 3 3	7	

2	Pressure, P = 800000 N/m^2 a) Pressure head , h= $\frac{P}{\rho\times g}=\frac{800000}{1000\times9.81}$=81.549 m b) Density= 0.8×1000=800 Kg/m^3 Pressure head , h= $\frac{P}{\rho\times g}=\frac{800000}{800\times9.81}$=101.9368m c) Density=13600 Kg/m^3 Pressure head , h= $\frac{P}{\rho\times g}=\frac{800000}{13600\times9.81}$=5.996m	2 3 2	7	
3	When water flows in a pipe, it experiences some resistance to its motion, due to which its velocity and ultimately the head of water available is reduced. This loss of energy (or head) is classified as follows : A. Major Energy Losses This loss is due to friction. B. Minor Energy Losses These losses are due to : 1. Sudden enlargement of pipe, 2. Sudden contraction of pipe, 3. Bend of pipe, 4. An obstruction in pipe, 5. Pipe fittings, etc	2 5	7	
4	1. Co-efficient of Contraction (Cc) :- The ratio of the area of the jet at vena-contracta to the area of the orifice is known as Co-efficient of contraction. It is denoted by Cc.	2	7	

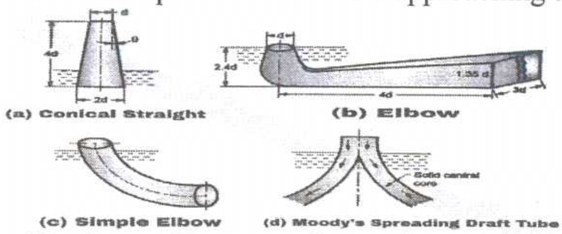
	Let, A_c = Area of jet at vena contracta, and A = Area of orifice. $Cc. = \frac{Ac}{A}$ 2. Co-efficient of Velocity (C_v):-The ratio of actual velocity (V) of the jet at vena-contracta to the theoretical velocity (Vth) is known as Co-efficient of velocity. It is denoted by C_v $Cv = \frac{\text{Actual velocity of jet at vena contracta}}{\text{Theoretical velocity}}$ 3. Co-efficient of Discharge C_d:- The ratio of actual discharge (Q) through an orifice to the theoretical discharge,(Q_{th}) is known as Co-efficient of discharge. It is denoted by C_d. $C_d = \frac{\text{Actual discharge}}{\text{Theoretical discharge}}$. $C_d = Cv \times Cc$	2 3		
5	Diameter of the pipe, D = 350 mm = 0·35 m Length of the pipe, L = 75 m Velocity of flow, V = 2·8 m/s Chezy's constant, C = 55 Kinematic viscocity of water, v = 0·012 stoke = $0{\cdot}012 \times 10^{-4} m^2/s$ co-efficient of friction, f= 0.00263 (i)Head loss due to friction, $h_f = \frac{4flv2}{2gd} = \frac{4\times0.00263\times75\times2.8\times2.8}{2\times9.81\times0.35}$ =0.9 m (ii)$V = C\sqrt{mi}$ C=55, $m = \frac{D}{4} = \frac{0.35}{4}$ =0.0875 m $2.8 = 55\sqrt{0.0875 \times i}$ i=0.0296 $i = \frac{hf}{l}$ hf=i × l =0.0296×75 =2.22m	1 3 3	7	
6	Inlet diameter of venturimeter, D_1 = 30cm = 0.3 m ∴ Area at inlet, A1 $= \frac{\pi}{4} \times 0.3^2 = 0.0707\ m^2$ Throat diameter, D_2 = 15cm = 0.15 m ∴ Area of throat, A2 $= \frac{\pi}{4} \times 0.15^2 = 0.0176$ m2 Reading of differential manometer, x = 20cm (= 0.2 m) of mercury Co-efficient of discharge, Cd = 0.98 $h = x\ [\frac{Sm}{So} - 1] = 0.2 \times [\frac{13.6}{1} - 1] = 2.52$ m of water	1 2	7	

	Q= $C_dA_1 A_2 \frac{\sqrt{(2gh)}}{\sqrt{(A1^2-A2^2}}$ =0.98×0. 0707×0. 0176×$\frac{\sqrt{(2\times9.81\times2.52)}}{\sqrt{(0.0707^2-0.0176^2}}$ = 0.1278 m^3/s	3 1		
7	Diameter of the nozzle/jet, d = 10cm = 0.1 m Velocity of water, V = 15 m/s Velocity of the plate, u = 6 m/s (i) The force on the plate, F = ρa $(V-u)^2$ = 1000 ×$\frac{\pi}{4}$ ×0.1^2 $(15-6)^2$ = 636.17 N Work done = F × u = 636.17 × 6 = 3817.02 Nm/s Kinetic energy of issuing jet=1/2 × ρaV^3 =1/2 × 1000×$\frac{\pi}{4}$ ×0.1^2 × 6^3 =13253.6 Nm/s Efficiency =$\frac{Work\ done}{Kinetic\ energy\ of\ issuing\ jet}$ =$\frac{3817.02}{113253.6}$× 100=28.8%	1 2 2 2	7	
8	 Kaplan Turbine consists of following main parts: • Turbine Shaft • Guide Vane • Runner Vanes • Scroll Casing • Draft Tube • Tail Race The water is entered into the spiral casing of the turbine. The turbine shafts connected with runner blades or turbine blades. The water comes to the guide vanes. Guide vane is like controlling the flow of water. Now if it opens the water strikes the runner	4 3	7	

	baldes.The runner strats rotating due to this turbine shaft also rotates. The turbine shafts is connected to the generator for electric generation. The water which is used for rotating the runner blades now will come to draft tube. And from Draft tube the water goes to tail race and to the river.			
9	**Unit Quantities:** 1] Unit speed. 2] Unit discharge. 3] Unit Power **1] Unit speed**:-It is defined as the speed of a turbine working under a unit head (i.e. under a head of 1m) it is denoted by 'Nu' $Nu = N/ \sqrt{H}$ **2] Unit Discharge:**-It is defined as, the discharge passing through a turbine, which is working under a unit head (i.e. lm). It is denoted by the symbol 'Qu' $Qu=Q/ \sqrt{H}$ **3] Unit power:**-It is defined as the power developed by a turbine, working under a unit head. it is denoted by 'Pu' $p_u=P/H^{3/2}$	1 2 2 2	7	
10	1. Conical draft tube:- In this type of draft tube form, the flow direction is straight and divergent. This tube style is made of mild steel plates. It is tapered in shape and the outlet diameter is greater than the inlet diameter of the draft tube 2. Simple elbow draft tube:- This draft tube is used at low head positions and the turbine is to be mounted next to the tailrace. It helps to minimize the expense of drilling and the exit diameter should be as wide as possible to recover kinetic energy at the runner outlet. This tube has a moderate efficiency of around	1 1 1 1	7	

60%.

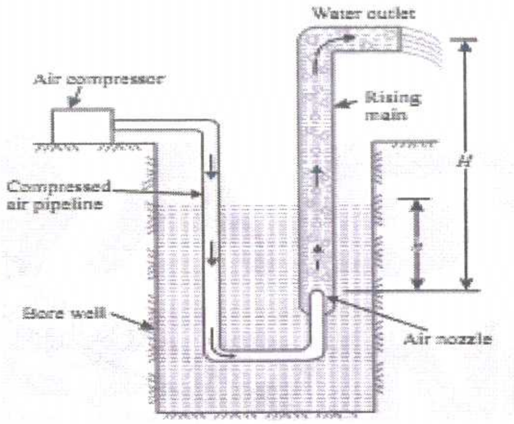
3. Moody spreading draft tube:- The outlet of the draft tube is split into two sections in this form of the draft tube. Moody draft tube is similar to a conical draft tube and is with a central core component that divides the outlet into two parts 1 2
4. Elbow draft tube with a varying cross-section:- An elbow draft tube with varying cross-section is an improvement of a simple elbow draft. The inlet is circular and the outlet is rectangular in this type. In general, the horizontal section of the draft tube is inclined up to avoid air from approaching the exit area.



Various Types of Draft Tubes

11 — 7 — 7

Reciprocating Pump	Centrifugal Pump
The discharge is fluctuating and pulsates.	Here, The discharge is continuous and smooth.
The reciprocating pump handles a small number of liquids but whereas	The centrifugal pump handles a large number of liquids or fluids.
It is used for only pure water or less viscous fluid.	This can be used for lifting highly viscous fluid.
This is used for small discharges and high heads. But Reciprocating Pump	Used for large discharge through smaller heads.
Reciprocating Pump has low efficiency.	Centrifugal Pump has high efficiency.
The installation cost is more.	The installation cost is less.
The maintenance cost is also more.	The maintenance cost is also less.
This one needs a larger floor area.	This one needs a smaller floor area.
The reciprocating pump is complicated to operate and with much noise.	The centrifugal pump is smooth in operation and without much noise.
This pump runs at a low speed because of cavitation and separation.	This pump runs at a high speed.
Reciprocating Pump cost is more. It cost us around 3 to 4	Centrifugal Pump cost is less.

<table>
<tr><td></td><td><table><tr><td>times of centrifugal pump cost.</td><td></td></tr><tr><td>The torque is not uniform here.</td><td>In this Torque is uniform.</td></tr></table>(Any 7)</td><td></td><td></td><td></td></tr>
<tr><td>12</td><td>

It consists of a source of compressed air and an air pipeline fitted with one or more nozzles and an open vertical pipe or rising main as shown in Fig. The compressed air is introduced at the bottom of the rising main and it issues from set of air nozzles in the form of a fine spray. The air mixes with water in the rising main and reduces the density of air-water mixture. As soon as the pressure of the column of air-water mixture in the rising main of height H becomes less than the pressure due to the height of water column h in the bore well, the water begins to flow at the outlet of the rising main. The flow rate depends upon the density of the mixture' in the rising main/delivery pipe.</td><td>4

3</td><td>7</td><td></td></tr>
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