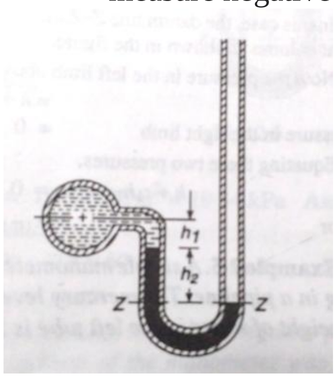
Important Instructions to examiners:

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 the candidate and those in the 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 the model answer.
6) In case of some questions credit may be given by judgment 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.

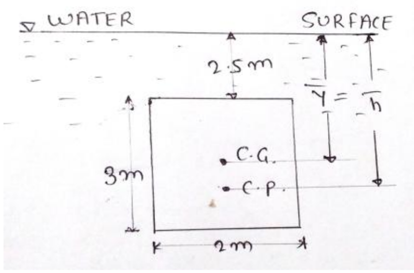
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1		**Attempt any <u>TEN</u> of the following:**		**20**
	(a)	**Define Surface Tension. State its units.** **Ans.** **Definition**- the tension of the surface film of a liquid caused by the attraction of the particles (cohesion) in the surface layer by the bulk of the liquid, which tends to minimize surface area. Surface tension is denoted by Greek letter 'σ'. **Unit:-**surface tension= force/length 'σ' = N/m.	**1** **1**	**2**
	(b)	**State any two applications of hydraulics with respect to Irrigation**. **Ans.** Applications of hydraulics with respect to Irrigation are as follows- • To calculate discharge flowing through canal. • For distribution of equal water for city or agriculture purpose using water meter. • To determine velocity of flow at a point in open channel. • The total pressure and Centre of pressure acting on dam face at the point the resultant cuts the base of the can be determined. • Spillway can also designed to pass off water on D/S of a dam.	**1 Mark each (any two)**	**2**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**(c)**	**State 'Pascal Law' of liquid pressure** **Ans.** **Statement**-"Pascal's law state that at a point in a fluid at rest intensity pressure acts equally in all direction". **Explanation:** - consider one particle of a liquid on a jar the pressure exerted on that point all direction is same. 	**2**	**2**
	(d)	**How will you measure negative pressure?** **Ans.** • By using U Tube **manometer:** it is an instrument that measure negative pressure.  Pressure head on lift limb = pressure head on right limb above z-z dat $h_A + h_1 s_1 + h_2 s_2 = 0$ $h_A = -(h_1 s_1 + h_2 s_2)$	**1** **1**	**2**
	(e)	**Define Reynold's number.** **Ans.** Definition: - The Reynolds number is defined the ratio of inertia force to viscous force. $$\mathrm{Re} = \frac{\text{inertial forces}}{\text{viscous forces}} = \frac{\rho \mathbf{v} L}{\mu} = \frac{\mathbf{v} L}{\nu}$$ Where, Re- Reynold's Number. ρ - Is the mass density of the fluid (kg/m^3). μ is the dynamic_viscosity of the fluid (Pa·s or $N{\cdot}s/m^2$ or kg/(m·s ν (nu) is the kinematic viscosity ($\nu = \mu/\rho$) (m^2/s)	**1** **1**	**2**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	(f)	**State any two causes of water Hammer.** **Ans.** **Causes of water hammer-** • A water hammer commonly occurs when fluid flowing with high velocity in the pipe is brought to rest with a valve closes suddenly at an end of a pipeline system. • A pressure wave propagates in the pipe.	1 Mark each	2
	(g)	**Write modified Darcy-Weisbach equation.** **Ans.** Modified Darcy-Weisbach equation is as following :- $H_f = \frac{f L V^2}{2 g D}$ But, $V = \frac{Q}{A} = \frac{Q}{\frac{\pi}{4} D^2} = \frac{4Q}{\pi D^2}$ **So,** $H_f = \frac{f L}{2 g D} \left(\frac{4 Q}{\pi D^2}\right)^2$ $H_f = \frac{f L Q^2}{12.1 \ D^5}$ Where, V = Velocity of flowing fluid. f = coefficient of friction. H_f = Head loss due to friction. L = Length of pipe. g = Acceleration due to gravity. D = Diameter of pipe. Q = Discharge through pipe. A = Area of pipe.	1 1	2
	(h)	**Define 'hydraulic Mean depth' and its units.** **Ans.** The hydraulic Mean depth is the ratio of the weighted area to the weighted perimeter. Therefore, $R = \frac{A}{P}$ Where, R = Hydraulic mean depth, (m). A = Weighted Area, (m^2). P = weighted perimeter, (m). The unit of hydraulic mean depth is 'm'.	1 1	2
	(i)	**State the conditions for maximum discharge through trapezoidal channel.** **Ans.** Following are conditions for maximum discharge through trapezoidal channel 1. $R = \frac{D}{2}$ 2. $\frac{b + 2nd}{2} = d\sqrt{n^2 + 1}$	1 mark each	2

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**(j)**	**What is the difference between a 'notch' and a 'weir'** **Ans.**		
		Sr.No. | **Notch** | **Weir**		
		1 | Notch is of small sizes. | Weir is of bigger sizes.	**1 mark each**	
		2 | Notch is made in plate. | Weir is made in masonry and Concrete		**2**
	(k)	**Enlist various hydraulic coefficients for orifice and state relation between them.** **Ans.** Following are the hydraulic coefficient for orifice 1. Coefficient of discharge (C_d). 2. Coefficient of contraction (C_c). 3. Coefficient of velocity (C_v).	**1**	
		Relation between them, $C_d = C_v \times C_c$	**1**	**2**
	(l)	**Differentiate between the turbines and pumps on any two factors.** **Ans.**		
		Sr. No. | **Turbine** | **Pump**		
		1 | It is a Machine that convert hydraulic energy into mechanical energy. | It is a device that converts mechanical energy into hydraulic energy.	**1 mark each**	
		2 | Turbines are used for electricity generation | Pumps are used for pressure generation.		**2**

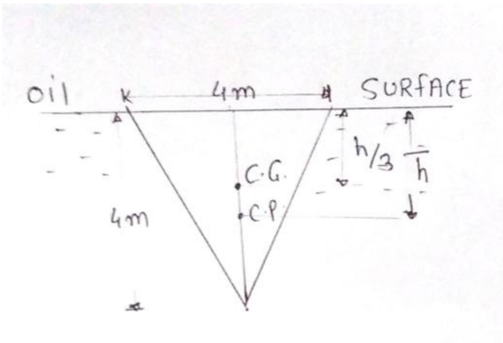
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2		**Attempt any <u>FOUR</u> :**		16
	(a)	**State the Newton's law of viscosity and give example of its application.**		
		Ans.		
		Statement:-		
		Newton's law states that "shear stress in fluid layers is directly proportional to velocity gradient".	1	
		Mathematically, $\tau \propto \frac{du}{dy}$		
		$\tau = \mu \frac{du}{dy}$	1	
		Where, τ = Shear stress. μ = dynamic viscosity. $\frac{du}{dy}$ = velocity gradient.		
		Example of Application:- 1. To design pipe.	2	4
	(b)	**Determine specific gravity of fluid having viscosity 0.05 poise. And kinematic viscosity 0.035 stokes.**		
		Ans.		
		Given : μ = 0.05 poise $= 0.05 \times 10^{-1}$ N-s/m^2. ν = 0.035 stokes $= 0.035 \times 10^{-4}$ m^2/sec.		
		We know, Sp. Gravity of liquid = $\frac{\text{mass density of liquid}}{\text{mass density of standard water}}$	1	
		$= \frac{\rho l}{\rho w}$		
		But, $\nu = \frac{\mu}{\rho l}$		
		$0.035 \times 10^{-4} = \frac{0.05 \times 10-1}{\rho l}$	1	
		ρ l = 1428.57 kg/m^3.	1	
		We know, Mass density of standard water = 1000 kg/m^3.		
		Sp. Gravity (S) = $\frac{1428.57}{1000}$		4
		S = 1.42	1	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(c)**	**A rectangular plane surface is 2 m wide and 3m deep. It lies in vertical plane in water. Determine the total pressure and position of centre of pressure on the plane surface when its upper edge is horizontal and 2.5 m below the free water surface.** **Ans.** 	1	**16**
		Given - B = 2 m. D = 3 m. D = 2.5 + 1.5 = 4 m Total Pressure = ? Position of centre of pressure = ? 1. Total Pressure = P = W_l A D. Area = A = 2x3 = 6 m^2. W_l = 9.81 KN/m^3.	1	
		Hence, Total Pressure = 9.81 x 6 x4 **P = 235.44 KN**	1	
		2. Position of centre of pressure = $\bar{h} = \frac{IG}{A\bar{y}} + \bar{y}$. IG = $\frac{b\,d^3}{12} = \frac{2*3^3}{12}$ = 4.5 m^4. Area = A = b * d = 2*3 = 6m^2 Hence, $\bar{h} = \frac{4.5}{6*4} + 4$. **$\bar{h}$ = 4.1875 m.**	1	4

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**d)**	**Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4 m and altitude 4 m when it is immersed vertically in an oil of sp. Gravity 0.9 the base of the plate co insides with the free surface of oil.**		

Ans.

Given :



B = 4 m

H = 4 m.

Total Pressure = ?

Position of centre of pressure = ?

1. Total Pressure = P = $S_{oil}\, W_w A\, \bar{y}$.

$$\text{Area} = A = \frac{bh}{2}$$

$$A = 8\ m^2.$$

$$\bar{y} = \frac{h}{3} = \frac{4}{3} = 1.33\ m.$$

Hence,

Total Pressure = P = 0.9 X 9.81 X 8 X 1.33. **1**

P = 93.94 KN **1**

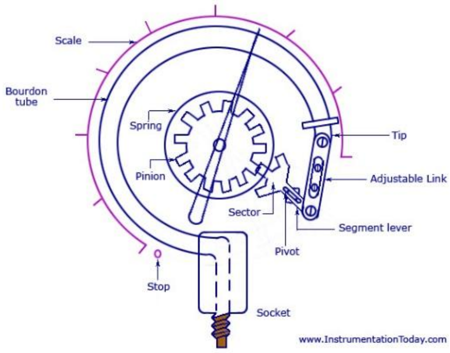
2. Position of centre of pressure = $\bar{h} = \frac{IG}{A\,\bar{y}} + \bar{y}$

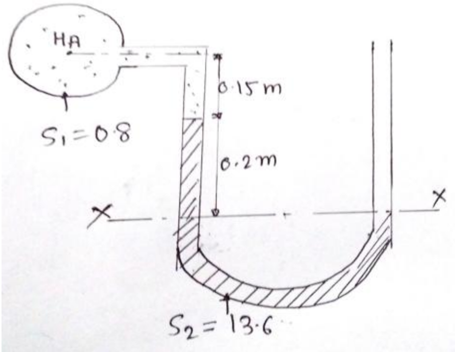
$$IG = \frac{b\,h^3}{36} = \frac{4 * 4^3}{36} = 7.11\ m^4.$$ **1**

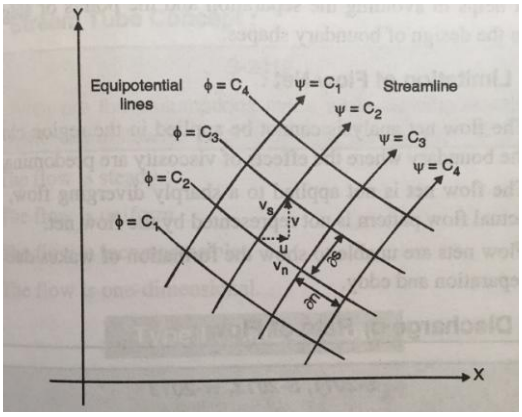
Hence,

$$\bar{h} = \frac{7.11}{8 \times 1.33} + 1.33.$$ **1**

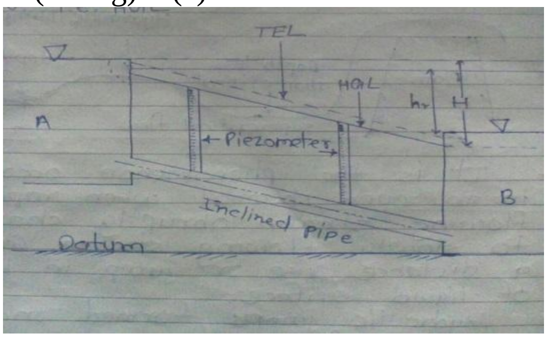
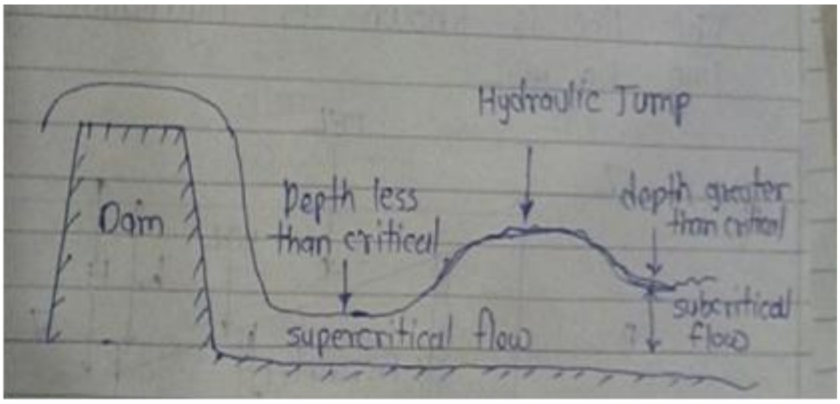
$\bar{h}$ = 1.99 ≈ 2 m. **Total Marks: 4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(e)**	**Explain briefly the working principle of Bourdon pressure gauge with a neat sketch.** **Ans.**  Bourdon Tube Pressure Gauge	**2**	
		Working : The pressure to be measured is connected to the fixed open end of the bourdon tube. The applied pressure acts on the inner walls of the bourdon tube. Due to the applied pressure, the bourdon tube tends to change in cross – section from elliptical to circular. This tends to straighten the bourdon tube causing a displacement of the free end of the bourdon tube. This displacement of the free closed end of the bourdon tube is proportional to the applied pressure. As the free end of the bourdon tube is connected to a link – section – pinion arrangement, the displacement is amplified and converted to a rotary motion of the pinion. As the pinion rotates, it makes the pointer to assume a new position on a pressure calibrated scale to indicate the applied pressure directly. As the pressure in the case containing the bourdon tube is usually atmospheric, the pointer indicates gauge pressure.	**2**	**4**
	(f)	**A simple manometer (U tube) containing mercury is connected to a pipe in which an oil of sp. Gr. 0.8 is flowing. The pressure in the pipe is vacuum. The other end of the manometer is open to the atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 20 cm and height of oil in the left limb from Centre of pipe is 15 cm below.** **Ans.** Given : $S_1 = 0.8$ $H_1 = 15$ cm. = 0.15 m. $H_2 = 20$ cm = 0.2 m. $S_2 = 13.6$		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(f)**	 		
		We know that,		
		Pressure head in left limb = Pressure head right limb above x-x axis		
		$H_A + H_1S_1 + H_2 S_2 = 0$	**1**	
		$H_A = - (0.15 \text{ x } 0.8) – (0.2 \text{ x } 13.6)$.		
		H_A = -2.84 m of water.		
		$= \frac{-2.84}{0.8}$ = - 3.55 m for oil.	**1**	
		Vacuum Pressure = $S_{oil}W_w H_A$	**1**	
		= 0.8 x 9.81 x 3.55		
		P = 27.86 KN/m^2.	**1**	**4**

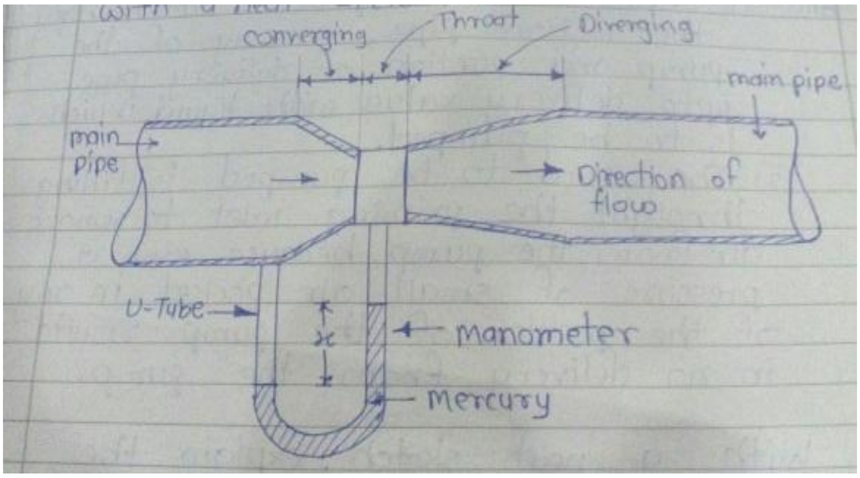
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3		**Attempt any FOUR :**		**16**
	(a)	**Explain the terms:** **i) Streak Line ii) Stream Line** **Ans.** **i) Streak Line:** It is imaginary line in a fluid flow helping to better understand the flow. Streak line is the locus of all the points that have gone through a given point in the flow.	**2**	
		ii) Stream Line: A stream line is defined as a continuous line in a fluid which shows the direction of velocity of fluid at each point along line.	**2**	**4**
	(b)	**State the uses of flow net with its sketch.** **Ans.** **Uses of flow net -** 1) To check the problems of flow under hydrostatic structure like dams etc. 2) for determination of seepage pressure 3) To find exit gradient 4)A flow net analysis assists in the design of an efficient boundry shapes	**1 mark each (any two)**	
			**2**	**4**

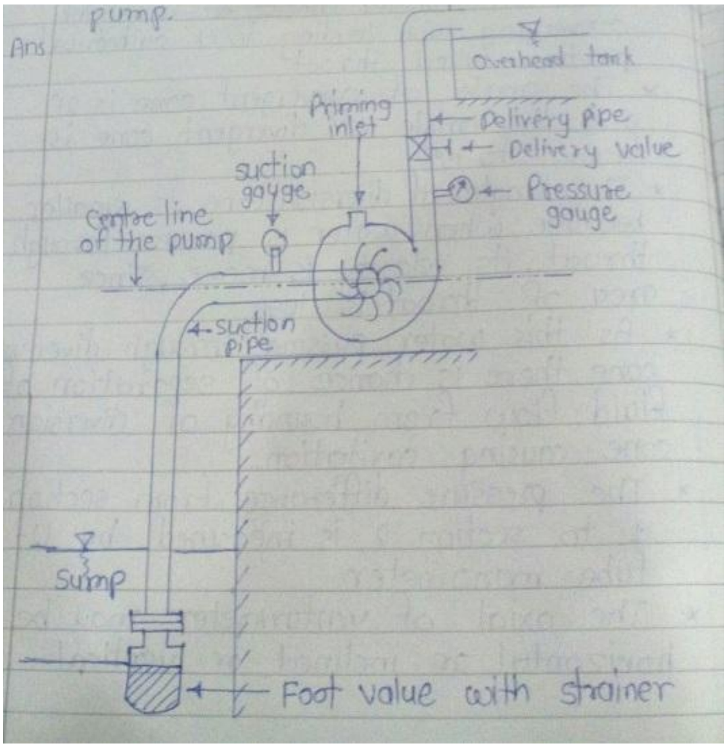
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**(c)**	**Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm the rate of flow of water through the pipe is 250 LPS.** **Ans.** Given d_1=200mm=0.2m d_2=400mm=0.4m Q = 250LPS = 250×10^{-3} m^3/s $\mathbf{a_1} = \pi/4 \times (0.2)^2 = 0.031m^2$ $\mathbf{a_2} = \pi/4 \times (0.4)^2 = 0.125m^2$ $Q = a_1 \times v_1$ $250 \times 10^{-3} = 0.03 \times v_1$ $\mathbf{V_1 = 8.06\ m/s}$ $Q = a_2 \times v_2$ $250\times10^{-3} = 0.125 \times v_2$ $\mathbf{V_2 = 2\ m/s}$ $H = (v_1 - v_2)^2 /2g$ $= (8.06-2)^2 / 2 \times 9.81$ **H = 1.871 m**	 1 1 1 1	 4
	(d)	**An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 LPS. find the head loss due to friction for a 500 m length of pipe. Take f=0.02** **Ans.** Given D = 200 mm = 0.2m Q = 60 LPS = 60×10^{-3} m^3/s L = 500m f = 0.02 $\mathbf{H_f = fLQ^2 / 12.1D^5}$ $H_f = (0.02 \times 500 \times (60 \times 10\text{-}3)^2) / (12.1 \times (0.2)^5)$ $\mathbf{H_f = 9.29\ m.}$	 1 2 1	 4
	(e)	**Define HGL and TEL with sketch.** **Ans.** **HGL -** 1) Due to friction the pressure head decreases gradually from section of the pipe in the direction of flow 2) If the pressure head at the different section of the pipe are plotted to the scale as vertical ordinate above the axis of the pipe 3) All the points are joint by the straight line, we get a straight sloping line. This line is known as "Hydraulic Gradient line"	 1 ½	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**(e)**	**TEL -** 1)when the total energy at the various points along the axis of the pipe is plotted and joint by the line, the line obtained is called as "Total Energy line"(TEL) or Total energy gradient (TEG) Total energy line is the line which gives sum pressure head, datum head and kinetic head of a flowing fluid TEL = (P / Y) + (v^2 / 2g) + (z)	**1 ½**	
		 	**1**	**4**
	(f)	**What do you mean by Hydraulic jump? Explain with sketch?** **Ans.** 1) It is the phenomenon occurring in an open Chanel when rapidly flowing stream abruptly change to slowly flowing stream causing a distance rise or jump in level of liquid surface 2) Hydraulic jump formed on a horizontal floor of canal and at the downstream side of spillway, at the downstream side of sluice gate, or at the downstream side of canal fall	**1**	
		 	**2**	
		Uses of Hydraulic Jump: This phenomenon is used in hydraulic structures constructed for irrigation, water supply works such as: 1) Energy dissipation below the spillway of dam 2) Mixing of chemicals in water treatment plants 3) Retaining head in canal if head drops due to losses in long canals	**1**	**4**

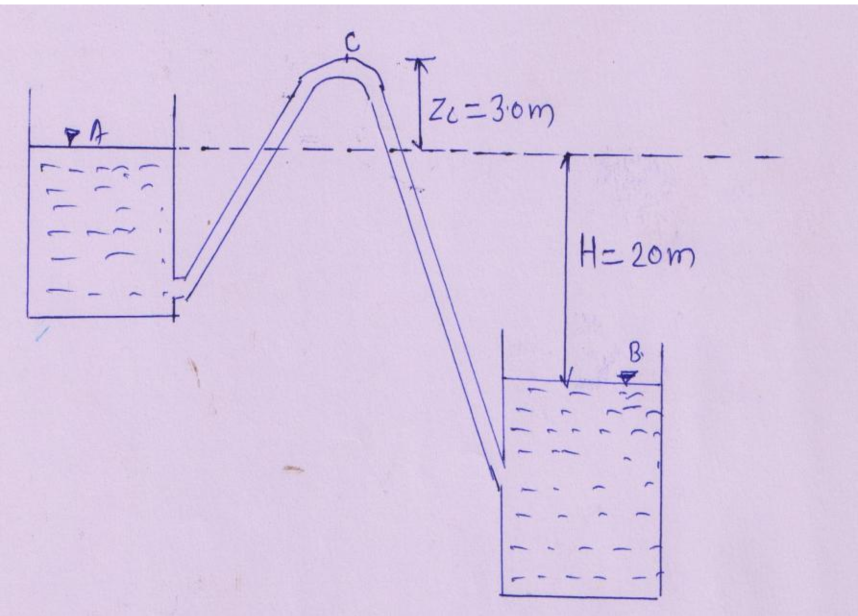
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4		**Attempt any <u>FOUR</u> :**		**16**
	(a)	**Find the bed slope of trapezoidal channel of bed width 6m, depth of water 3m and side slope of 3H to 4V when the discharge through channel is 30 m³/sec. Take Chezey's constant, C=70.** **Ans.** Given b = 6m d = 3m n = 3 / 4 = 0.75 Q = 30 m^3/s C = 70		
		$A = bd + nd^2$ $= (6 \times 3) + (0.75 \times 3^2)$ $= 24.75\ m^2$	**1**	
		$P = b + 2d\sqrt{(1+n^2)}$ $= 6 + 2 \times 3\sqrt{(1+0.75^2)}$ $= 13.5$ m	**1**	
		R = A / P = 24.75 / 13.5 = 1.83 m	**1**	
		$Q = AC\sqrt{RS}$ $30 = 24.75 \times 70 \times \sqrt{1.87} \times S$ $30 = 2343.68 \times \sqrt{S}$ $\sqrt{S} = 0.012$ $S = 1.44 \times 10^{-4}$ **S = 1 / 6944.44**	**1**	**4**
	(b)	**Find the discharge through a rectangular channel of width 2m, having a bed slope of 4 in 8000. The depth of flow is 1.5 m and takes the value of N in Manning's formula as 0.012.** **Ans.** Q = ? b = 2m d = 1.5 m N = 0.012		
		A = bd $= 2 \times 1.5$ $= 3\ m^2$	**1**	
		P = b + 2d $= 2 + 2 \times 1.5$ = 5m	**1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	(b)	**R = A / P** = 3 / 5 = 0.6 m **$Q = A / N \times R^{2/3} \times S^{1/2}$** $= (3/0.012)\times(0.6)^{2/3} \times(1/2000)^{1/2}$ Q = 3.976 m³/s	1 1	4
	(c)	**A rectangular channel 2m wide has a discharge of 250 lit/sec, which by right angle V notch weir. Find the position of apex of the notch from the bed of channel if maximum depth of water is not to exceed 1.3 m. Take Cd=0.62** **Ans.** Given b =2 m Q = 250×10^-3 ϕ = 90° Max d = 1.3 m = H' **$Q = (8/15) \times Cd \times \sqrt{(2g)} \times \tan(\phi /2) \times H^{5/2}$** $250\times10^{-3} = (8/15) \times 0.62 \times \sqrt{(2\times9.81)} \times \tan (90/2) \times H^{5/2}$ $250\times10^{-3} = 1.465 \times H^{5/2}$ $250\times10^{-3} = 1.465\times H^{5/2}$ $250\times10^{-3} / 1.465 = H^{5/2}$ $H^{5/2} = 0.170$ **H = 0.493 m** Apex height = 1.3 - 0.493 **= 0.806 m**	1 1 1 1	4
	(d)	**Explain the working of venturimeter with a neat sketch.** **Ans.** **Working-** i. The venturimeter consist of a short converging tube leading to a cylindrical portion called throat. ii. The angle of convergent cone is 21° and the angle of divergent cone is from 7° to 15°. iii. The angle of divergent cone is smaller because when water is passing through throat, its velocity is more, since area of throat is less. iv. As this water passing through diversion cone there is chance of separation of fluid flow from boundary of diversion cone causing cavitation. v. The pressure difference from section 1 and section 2 is measured by U tube manometer. vi. The axis of venturimeter may be horizontal or vertical or incline.	2	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**(d)**		2	4
	(e)	**What is Priming? Why is it necessary.** **Ans.** **Priming** is the process of filling the suction pipe of pump and portion of delivery pipe up to delivery valve with the liquid which is to be pumped. **Necessity-** i. The liquid to be pumped is filling through the priming inlet to remove air from the pump. ii. If a small air pocket is present in any portion of pump results in no delivery from pump.	2 2	4
	(f)	**With a neat sketch explain the principle and working of centrifugal pump.** **Ans.** **Principle-**When certain mass of liquid is made to rotate by an external force it is thrown away from the central axis of rotation and a centrifugal head is impressed which enables it to rise to higher level. **Working of centrifugal pump is in 3 stages** i. Priming ii. Starting iii stoping i. Priming- The operation of filling the casing, impeller and suction pipe upto delivery valve is called priming. ii. Starting- Before starting first of all check that priming is done and return valve is not in closed condition. iii. Stoping - To stop the pump, delivery valve should be closed partly. Motor is switched off and then value is closed fully.	1 2	

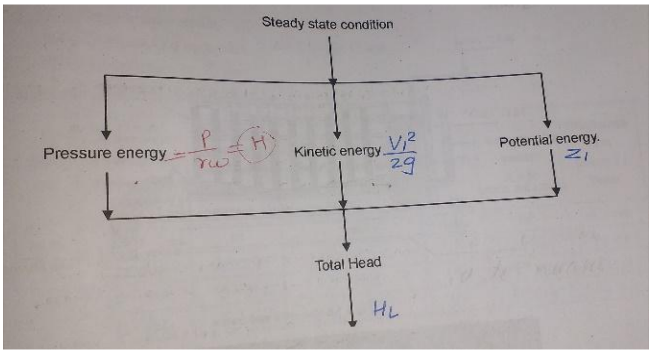
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**(f)**		**1**	**4**
Q.5		**Attempt any <u>TWO</u> :**		**16**
	(a)	**An oil of sp.gr 0.8 flowing through a venturimeter having inlet diameter 20cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take c_d =0.98**		
		Ans. S=0.8 D_1= 20cm = 0.2 m D_2=10cm = 0.1 m X = 25cm =0.25 m Cd =0.98 Q= ?		
		$h = x\left(\frac{Sm}{Sl} - 1\right)$ = 0.25 (13.6/0.8-1) = 4m	**1**	
		$a_1 = \frac{\pi}{4} {d_1}^2$ a_1 = 3.14/4x0.2^2 **= 0.0314 m^2**	**1**	
		$a2 = \frac{\pi}{4}\, d2^2$ a_2 = 3.14/4x0.1^2 **= 7.85x10^{-3} m^2**	**1**	

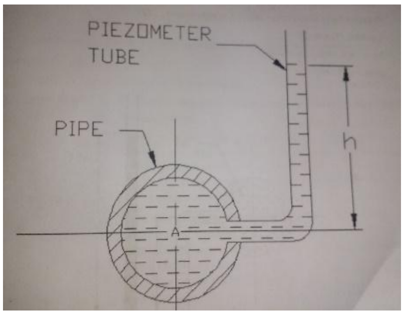
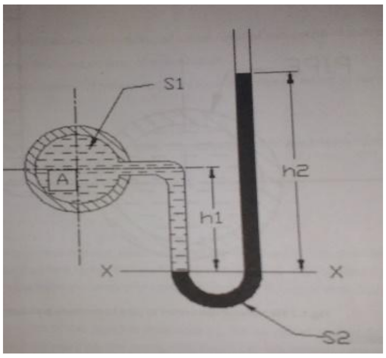
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**(a)**	$Q = \frac{Cd.a1.a2.\sqrt{(2gh)}}{\sqrt{(a1^2 - a2^2)}}$	**2**	
		$Q = \frac{0.98 \times 0.0314 \times 7.85 \times 10^{-3} \times \sqrt{2 \times 9.81 \times 4}}{\sqrt{0.0314^2 - (7.85 \times 10^{-3})^2}}$	**2**	
		Q = 0.0704 m^3/s	**1**	**8**
	(b)	**A trapezoidal Channel has side slopes of 3 H to V and slope of its bed is 1 in 2000. Determine the optimum dimensions of the channel, if its is to carry water at 0.5m^3/s. Take Chezy's constant as 80.**		
		Ans		
		Q = 0.5 m^3/s		
		S = 1/2000		
		n = ¾ = 0.75		
		c = 80		
		For the most economical trapezoidal section		
		Half of top width = sloping side		
		$\frac{b + 2nd}{2} = d\sqrt{1 + n^2}$	**1**	
		$\frac{b + 2 \times 0.75d}{2} = d\sqrt{1 + 0.75^2}$		
		$\frac{b + 1.5d}{2} = 1.25d$		
		b+1.5d = 2.5d		
		b = d	**1**	
		A= bd + nd^2		
		A= dd + 0.75 d^2		
		A= 1.75 d^2	**1**	
		$Q = AC\sqrt{RS}$	**1**	
		$0.5 = 1.75d^2 \times 80 \times \sqrt{\frac{d}{2} \times \frac{1}{2000}}$		
		Squaring both sides		
		$0.5^2 = (1.75d^2) \times 80^2 \times (d/2) \times (1/2000)$	**2**	
		$0.5^2 = 4.9\ d^5$		
		$d^5 = 0.5^2/4.9$		
		$d = 0.05102^{\frac{1}{5}}$		
		d = 0.551 m	**1**	
		b = d		
		b = 0.551 m	**1**	**8**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	c)	**A siphon of diameter 20cm connects two reservoirs having a difference in elevation of 20cm. the length of the siphon is 500m, and the summit is 3.0 m above the water level in the upper reservoir. The length of the pipe from upper reservoir to the summit is 100 m. Determine the discharge through the siphon and also pressure at summit. Neglect minor losses. Take coefficient of friction, f=0.005.**		
		Ans		
		Given,		
		d= 0.2 m		
		H = 20m		
		L = 500m		
		Z_c = 3 m		
		l = 100m as the coefficient of friction is given use f=0.005		
		Q = ? P = ?		
		Diagram-		
			1	
		$h_f = \frac{(4f)\, L V^2}{2gd}$	1	
		$20 = \frac{(4 \times 0.005)\, 500\, V^2}{2 \times 9.81 \times 0.2}$		
		$20 = 0.637 \times 4V^2$		
		$V^2 = 7.848$	1	
		V = 2.801 m/s		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**c)**	**Discharge** $Q = a\,V$ $Q = \frac{\pi}{4} \times 0.2^2 \times 2.8014$ **Q = 0.0879 m^3/s**	1	
		Pressure at summit - Applying Bernoulli's equation between A and C $\frac{P_A}{\gamma_c} + \frac{{V_A}^2}{2g} + Z_A = \frac{P_C}{\gamma_C} + \frac{{V_C}^2}{2g} + Z_C + Losses$	1	
		$0 = \frac{P_C}{\gamma_C} + \frac{2.801^2}{2 \times 9.81} + 3 + (\frac{4 \times 0..005 \times 100 \times 2.801^2}{2 \times 9.81 \times 0.2})$	1	
		$0 = \frac{P_C}{\gamma_C} + 3.39 + 4$ $0 = \frac{P_C}{9810} + 7.39$ $P_C = -72.49\ KN/m^2$ **$P_C = 72.49\ KN/m^2$ (vaccum)**	2	8

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6		Attempt any **TWO** :		**16**
	(a)	**A circular plate 3.0 m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and position of the center of pressure.**		
		Ans.		
		Given,		
		$A = \frac{\pi}{4} 3^2$		
		A = 7.0685 m^2	**1**	
		$I_G = \frac{\pi}{64} d^4$		
		$I_G = \frac{\pi}{64} 3^4$		
		I_G = 3.976	**1**	
		Total pressure		
		$P = \Upsilon_w A \bar{y}$		
		P = 9810 x 7.0685 x[(4+1.5)/2]		
		P =190690.45 N/m^2		
		P = 190.690 KN/m^2	**2**	
		Centre of pressure		
		$h = \bar{y} + \frac{I_G \sin^2 \theta}{A \bar{y}}$	**1**	
		$\bar{y} = \frac{4 + 1.5}{2} = 2.75\, m$		
		Sin Ө = 2.5/3= 0.833		
		$h = 2.75 + \frac{3.976 \times 0.8333^2}{7.0685 \times 2.75}$	**2**	
		h = 2.89 m	**1**	
				8

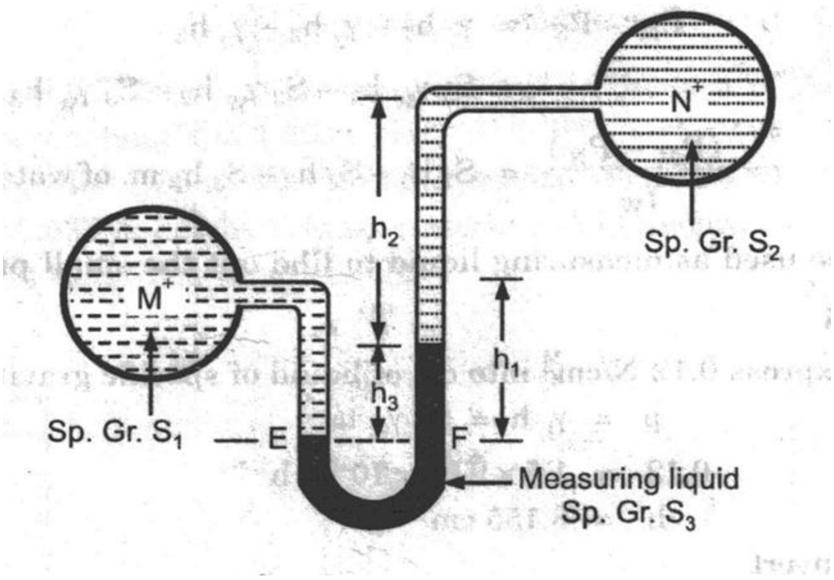
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**(b) (i)**	**State Bernoulli's theorem** **Ans.** Statement - It states that in an ideal incompressible fluid, when the flow is steady and continuous the sum of pressure energy ,kinetic energy and potential energy (or datum)energy along a stream line Mathematically $p/\gamma + v^2/2g + z$=constant where, p/γ = pressure energy $v^2+/2g$ = Kinetic energy z = datum 	**1** **1** **2**	**4**
	(ii)	**A pipeline carry oil of sp.gr 0.87, changes in diameter from 200mm diameter a position a to 500 mm diameter at a position B which is 4 m at a higher level. If the pressure at 'A' and 'B' are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 lit/sec. Determine the loss of head and direction flow.** **Ans.** D_A = 200 mm D_B = 500 mm Z = 4 m $P_{A =}$ 9.81 N/cm^2 = 98100N/m^2 $P_{B =}$ 5.886 N/cm^2 = 58860N/m^2 Q = 200 X 10^{-3} **$Q = a_A X V_A$** $200 \times 10^{-3} = \frac{\pi}{4} 0.2^2 \times V_A$ **V_A = 6.36 m/s**	½	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**(b)**	**$Q = a_B \times V_B$** $200 \times 10^{-3} = \frac{\pi}{4} 0.5^2 \times V_B$ **$V_B = 1.01$ m/S** Using Bernoulli's equation $\frac{P_A}{\gamma_A} + \frac{V_A^2}{2g} + Z_1 = \frac{P_B}{\gamma_B} + \frac{V_B^2}{2g} + Z_2 + H_L$ $\frac{98100}{0.87 \times 9810} + \frac{6.36^2}{2 \times 9.81} + 0 = \frac{58860}{0.87 \times 9810} + \frac{1.01^2}{2 \times 9.81} + 4 + H_L$ $13.595 = 10.948 + H_L$ **$H_L = 2.667$m** Flow is from A to B	½ 1 1 1	4
	(c)	**Explain the following with neat sketches:** **1. Simple manometer and its types** **2. Differential manometer and its types** **Ans.** There are two types of simple manometer 1. Piezometer 2. Simple U tube manometer **Piezometer-**  **$P = \gamma h$** **Simple U tube manometer -** It is the simplest form of manometer  **$h = h_2S_2 - h_1S_1$(m of water)** **$p = \gamma h$**	1 1 1 1	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**(c)**	**Differential U tube monometers-**		

1. Differential U tube manometer
2. Inverted U tube Manometer

Differential U tube manometer –



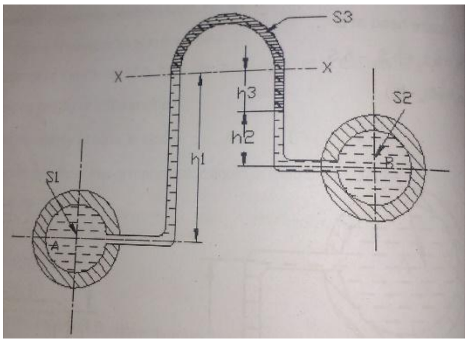
1

$$H_M - H_N = h_1 s_1 - h_3 s_3 - h_2 s_2$$

$$P_M - P_N = \gamma\,(H_M - H_N)$$

1

Inverted U tube Manometer –



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8

$$H_A - H_B = h_1 s_1 - h_2 s_2 - h_3 s_3$$

$$P_a - P_b = w\,(H_A - H_B)$$

1