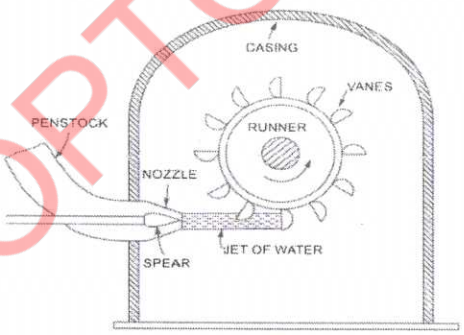
Set 2

Scoring Indicators

COURSE NAME : HYDRAULICS AND IRRIGATION ENGINEERING

COURSE CODE : 4012 **QID:**

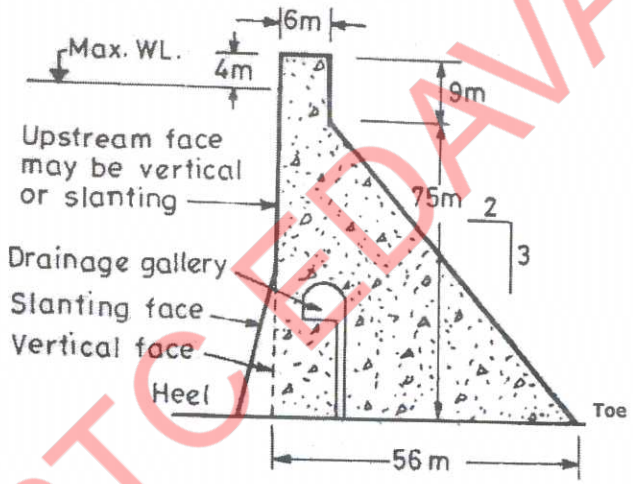
Q NO	Scoring Indicators	Split score	Sub Total	Total
	PART A			
	Answer all the following questions in one word or sentence.	**(9 x 1 = 9 Marks)**		
I 1.	Specific gravity	1	1	1
I 2.	Newton	1	1	1
I 3.	Total Energy Line	1	1	1
I 4	Wetted perimeter	1	1	1
I 5	Intensity of irrigation	1	1	1
I 6	Crop period	1	1	1
I 7	Balancing depth	1	1	1
I 8	Diversion headwork	1	1	1
I 9	Super passage/syphon	any one	1	1
	PART B			
	II. Answer any Eight questions from the following	**(8 x 3 = 24 Marks)**		
II 1	Pascals law states that the intensity of pressure at any point in a liquid at rest, is the same in all directions. In other words, when a certain pressure is applied at any point in a fluid at rest, the pressure is equally transmitted in all the directions and to every other point in the fluid.	3	3	3
II 2	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 B. Minor Energy Losses	1		
		Minor Energy 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.	1	3	3
		Major Energy Losses are due to friction	1		
II	3	Water, while flowing in a pipe, possesses some momentum on account of its motion. It has been experienced that if the flowing water is suddenly brought to rest by closing the valve, its momentum is destroyed, which causes a very high pressure on the valve. This high pressure is followed by a series of pressure vibrations. These pressure vibrations set up noises in the pipe, known as knocking. Such a knocking is often heard in water pipes, if the tap is turned off quickly. The sudden rise of pressure has the effect of hammering action on the walls of the pipe and, thus, is known as hammer blow or water hammer. Sometimes, the hammer blow is so high, that it may even burst the pipe.	3	3	3
II	4	The water from the reservoir flows through the penstock at the outlet of which nozzle is fitted. The nozzle increases the kinetic energy of water flowing through the penstock. At the outlet of the nozzle,the water comes out in the form of a jet and strikes the buckets of the runner.	2		
			1	3	3

II	5			any 3	3	3

S. No.	*Centrifugal pump*	*Reciprocating pump*
1.	Simple in construction, because of less number of parts.	Complicated in construction, because of more number of parts.
2.	Total weight of the pump is less for a given discharge.	Total weight of the pump is more for a given discharge.
3.	Suitable for large discharge and smaller heads.	Suitable for less discharge and higher heads.
4.	Requires less floor area and simple foundation.	Requires more floor area and comparatively heavy foundation.
5.	Less wear and tear.	More wear and tear.
6.	Maintenance cost is less.	Maintenance cost is high.
7.	Can handle dirty water.	Cannot handle dirty water.
8.	Can run at higher speeds.	Cannot run at higher speeds.
9.	Its delivery is continuous.	Its delivery is pulsating.
10.	No air vessels are required.	Air vessels are required.
11.	Thrust on the crankshaft is uniform.	Thrust on the crankshaft is not uniform.
12.	Operation is quite simple.	Much care is required in operation.
13.	Needs priming.	Does not need priming.
14.	It has less efficiency.	It has more efficiency.

II	6	Perennial irrigation system is that system of irrigation in which irrigation water is supplied as per the crop requirement at regular intervals, throughout the period from sowing to harvesting of the crop. The irrigation practised in a perennial irrigation system is known as perennial irrigation. The water for this system of irrigation may be obtained from rivers or wells or any other perennial sources of water.	3	3	3
II	7	In the furrow method of irrigation water is applied to the land to be irrigated by a series of long, narrow field channels called furrows which are dug in the land at regular intervals. The water flowing in the furrows infiltrates into the soil and spreads laterally to irrigate the land between the furrows. Thus whereas in each of the methods of irrigation by flooding described earlier almost the entire land is wetted, in the furrow method only a part of the land varying from one-half to one-fifth is wetted which results in reducing the evaporation losses	3	3	3

II	8	Major irrigation Scheme: Major irrigation schemes are those schemes which have a Culturable Command Areas of More than 10,000 hectares.	1		
		Medium irrigation Schemes: The Medium Irrigation Schemes have a CCA of 2,000-10,000 hectares.	1	3	3
		Minor Schemes: Those with Culturable command areas up to 2000 hectares.	1		
II	9	1. Saves water for extending irrigation 2. Water logging can be avoided 3.Reduces the cost of maintenance of canals 4.Permits water to flow at higher velocities 5. Checks growth of weeds on the canal bed 6. Prevents canal breaches	any 3	3	3
II	10		3	3	3

PART C

III.		**Answer all questions from the following**	**(6 x 7 = 42 Marks)**		
III	1	**Surface tension:** This property of a liquid which offers a tensile resistance at its surface is called surface tension. The surface tension of a liquid is measured in terms of the tensile strength of the surface film per unit width. SI unit is N/m	3.5		

	Capillarity: If molecules of certain liquid possess relatively greater affinity for solid molecules (adhesion > Cohesion), then it will wet a solid surface with which it is in contact and tend to rise at the point of contact, result that the liquid surface is concave upward and θ is less than 90 degree .On the other hand if the cohesion predominates, then the liquid will not wet the solid surface and the liquid surface will be depressed at the point of contact, with the result that the liquid surface is concave downward and θ is greater than 90 degree.The phenomenon of rise or fall of liquid surface relative to the adjacent general level of liquid is known as capillarity.	3.5	7	7
III 2	Manometers: Manometers are the devices used for measuring the pressure at a point in a fluid by balancing the column of fluid by the same or another column of liquid. They are classified as follows. 1. Simple manometers 2. Differential manometers Simple manometers are those which measure pressure at a point in a fluid contained in a pipe or a vessel. On the other hand differential manometers measure the difference of pressure between any two points in a fluid contained in a pipe or vessel. Common types of simple manometers are 1. Piezometer 2. U tube manometer *Piezometers:* It is the simplest form of manometer used for measuring gage pressures. One end of this manometer is connected to the point where pressure is to be measured and other end is open to the atmosphere *U tube manometer:*It consists of glass tube bent in U shape, one end of which is connected to a point at which pressure is to be measured and other end remains open to the atmosphere Most commonly used types of differential manometers are	2 2 2	7	7

1. U tube Differential manometer

2. Inverted U tube differential manometer

A differential U tube manometer consists of a U-tube, containing a heavy liquid, whose two ends are connected to the points, whose difference of pressure is to be measured 1

Inverted U tube differential manometer: This type of manometer is used for measuring difference of two pressures where the accuracy is the major consideration. It consists of an inverted U-tube, containing light liquid, whose two ends are connected to the points,(A and B) whose difference of pressures is to be found out.

III

3

Area, $A = \frac{b \times h}{2} = \frac{3 \times 3}{2} = 4.5 \text{ m}^2$

Specific gravity of oil, $S = 0.8$

The distance of C.G. from the free surface of oil, 2

$$\bar{x} = \frac{1}{3}h = \frac{1}{3} \times 3 = 1 \text{ m}$$

i) Total pressure on the plate, P: 1

We know that, $P = wA\bar{x}$

$= (0.8 \times 9.81) \times 4.5 \times 1$

$P = \mathbf{35.3\ kN\ (Ans.)}$

ii) Centre of pressure, $\bar{h}$:

Centre of pressure is given by the relation: 3

$$\bar{h} = \frac{I_G}{A\bar{x}} + \bar{x} = \frac{(bh^3/36)}{A\bar{x}} + \bar{x}$$

$$= \frac{(3 \times 3^3/36)}{4.5 \times 1} + 1$$

$\bar{h} = \mathbf{1.5\ m\ (Ans.)}$ 1

III

4

BERNOULLI'S EQUATION

Bernoulli's equation states as follows:

"In an ideal incompressible fluid when the flow is steady and continuous, the sum of pressure energy, kinetic energy and potential (or datum) energy is constant along a stream line." 2

Mathematically,

$$\frac{p}{w} + \frac{V^2}{2g} + z = \text{constant}$$ 2 7 7

where, $\frac{p}{w}$ = Pressure energy,

$\frac{V^2}{2g}$ = Kinetic energy, and

z = Datum (or elevation) energy.

Assumptions:

1. The fluid is ideal
2. The flow is steady
3. The flow is incompressible
4. The flow is irrotational

3

III 5

Solution. Inlet diameter of venturimeter, $D_1 = 200 \text{ mm} = 0.2 \text{ m}$

$\therefore$ Area of inlet, $A_1 = \frac{\pi}{4} \times 0.2^2 = 0.0314 \text{ m}^2$

Throat diameter, $D_2 = 100 \text{ mm} = 0.1 \text{ m}$

$\therefore$ Area of throat, $A_2 = \frac{\pi}{4} \times 0.1^2 = 0.00785 \text{ m}^2$

Pressure at inlet, $p_1 = 0.18 \text{ N/mm}^2 = 180 \text{ kN/m}^2$

$\therefore \quad \frac{p_1}{w} = \frac{180}{9.81} = 18.3 \text{ m}$

2

Vacuum pressure at the throat,

$\frac{p_2}{w} = -280 \text{ mm of mercury}$

$= -0.28 \text{ m of mercury} = -0.28 \times 13.6 = -3.8 \text{ m of water}$

Co-efficient of discharge, $C_d = 0.98$

$\therefore$ Differential head, $h = \frac{p_1}{w} - \frac{p_2}{w} = 18.3 - (-3.8) = 22.1 \text{ m}$

Rate of flow, Q:

Using the relation,

4

7 7

$$Q = C_d \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}, \text{ we have:}$$

$$= 0.98 \times \frac{0.0314 \times 0.00785}{\sqrt{(0.0314)^2 - (0.00785)^2}} \times \sqrt{2 \times 9.81 \times 22.1}$$

$$= \frac{0.000241}{0.0304} \times 20.82$$

or $Q = \mathbf{0.165 \text{ m}^3/\text{s (Ans.)}}$

1

III 6

Solution. Given :

Width of rectangular channel, $b = 6 \text{ m}$

Depth of channel, $d = 3 \text{ m}$

$\therefore$ Area, $A = 6 \times 3 = 18 \text{ m}^2$

Bed slope, $i = 1 \text{ in } 2000 = \frac{1}{2000}$

Chezy's constant, $C = 55$

Perimeter, $P = b + 2d = 6 + 2 \times 3 = 12 \text{ m}$

7 7

$\therefore$ Hydraulic mean depth, $m = \frac{A}{P} = \frac{18}{12} = 1.5 \text{ m}$

1

Velocity of flow is given by equation

4

$$V = C\sqrt{mi} = 55\sqrt{1.5 \times \frac{1}{2000}} = \mathbf{1.506 \text{ m/s. Ans.}}$$

Rate of flow, $Q = V \times \text{Area} = V \times A = 1.506 \times 18 = \mathbf{27.108 \text{ m}^3/\text{s. Ans.}}$

2

III 7

Duty of water is the relation between the area of the land irrigated and the quantity of water required to be supplied for growing a crop. It is usually defined as the area of land in hectares which can be irrigated for growing any crop if one cumec (one cubic metre per

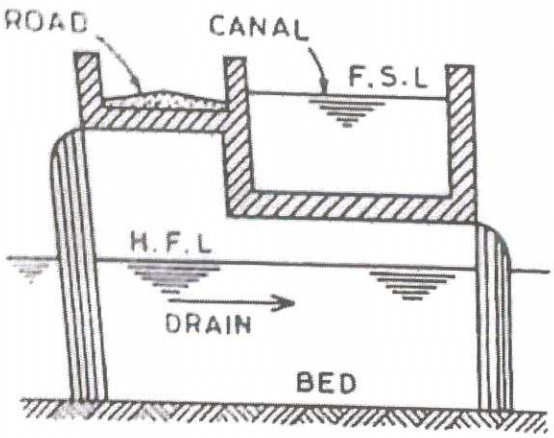
2

	second) of water is supplied continuously to the land for the entire base period of the crop.		7	7
	Delta is defined as the total depth of water over the irrigated land required by a crop grown on it during the entire base period of the crop. It is denoted by a symbol Δ (Greek "delta"). The delta for any crop may be determined by dividing the total quantity of water in hectare-metres required by the crop for its growth by the area of the land in hectares over which the crop is growing.	2		
	$\Delta = (8.64\ B/D) = (8.64 \times 120)/1500 = 690mm$	3		
III 8	Ridge Canal: A canal aligned along the ridgeline or watershed line of an area is said to be ridge canal or watershed canal. Since it is running at the peak altitude of the area, irrigation on both sides of the canal up to a larger extent of the area is possible.	3		
	Contour Canal: A canal aligned roughly parallel to the contours of the area is called a contour canal. This type of canal can be seen in hilly regions. Since it is parallel to the contour line, the ground on one side of the canal is higher and hence irrigation is possible only on the other side of the canal	2	7	7
	side-slope canal : A canal aligned nearly perpendicular to the contour of the area is called a side-slope canal. It is located neither on the ridgeline nor on the valley line but is approximately in between them. It is parallel to the natural drainage line and hence no cross drainage works are required.	2		
III 9	The canal headworks may be classified into the following two types.			
	(1) Storage headworks (2) Diversion headworks.	2		
	A storage headworks consists of a dam constructed across the river to create a reservoir in which water is stored during the period of excess flow in the river. From the reservoir water is supplied to the canal in required quantity as per the demand. Thus			

	a storage headworks stores water in addition to its diversion into the canal. A diversion headworks serves to raise the water level in the river and divert the required quantity into the canal.	3	7	7
	The diversion headworks may be classified into the following two types. (i) Temporary diversion headworks (ii) Permanent diversion headworks.	2		
III 10	(i) Rigid Dam. A rigid dam is that which is constructed with rigid material such as masonry, concrete, steel or timber. Earlier stone masonry was commonly used for the construction of dams, but now a days it is almost totally replaced by concrete. A steel dam is made of steel plates supported on inclined struts and a timber dam is made of wooden planks supported on a wooden framework. The steel and timber dams are constructed only for very small heights and these are rarely constructed.	3.5		
	(ii) Non-rigid Dam. A non-rigid dam is that which is constructed with non-rigid material such as earth, tailings, rockfill etc. There are four types of non-rigid dams viz., earth dam, tailings dam, rockfill dam and rockfill composite dam. An earth dam (or earthen dam) is constructed with gravel, sand, silt and clay. A tailings dam is built from the waste or refuse obtained from mines (or mine tailings). A rockfill dam consists of fragmental rock material supporting a water tight membrane on the upstream face. A rockfill composite dam consists of a rockfill on the downstream side and an earth fill on the upstream side. All these four types of non-rigid dams are normally classified under the category of embankment dams.	3.5	7	7

III 11	COMPONENTS OF DIVERSION HEADWORKS The various components of a diversion headworks are as follows. (1) Weir or Barrage:It is a barrier constructed across river.It raises water level in the river. (2) Divide wall or Divide groyne:It is a long solid wall constructed at right angles to the weir axis.It divides river channel into two compartments (3) Fish ladder:The structure provided for movement of fish from one side to the other (4) Pocket or Approach channel (5) Undersluices or Scouring sluice :These are openings provided in the body of a weir at low levels. The sluices are used to remove the silt or to score the deposited silt (6) Silt excluder: Devices provided on the river bed infront of the head regulator to exclude silt from water entering the canal (7) Canal head regulator: I it is a structure constructed at the entrance of the canal (8) River training works, such as Marginal bunds and Guide bunds	I mark/part 7	7
III 12	An aqueduct is just like a bridge in which instead of road or a railway, a canal is carried over a natural drain. An aqueduct is constructed where the bed of the canal is well above the high flood level (H.F.L.) of the drain. The canal water is taken across the drain in a trough supported on piers. The drain water flows under the canal such that there is sufficient headway available between the H.F.L. of the drain and the underside of the canal trough. The drain therefore flows at atmospheric pressure under the work. Further an inspection road is provided along with the trough.	3	

7 7



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Mark Distribution

Module	Hr / Module	(hi / ∑Hi) * 123	TYPE OF QUESTIONS							
			PART A		PART B		PART C		TOTAL	
			No of Questions	Marks	No of Questions	Marks	No of Questions	Marks	No of Questions	Marks
I	15	**31.8**	2	2	1	3	4	28	7	**33**
II	14	**29.7**	2	2	4	12	2	14	8	**28**
III	14	**29.7**	3	3	4	12	2	14	9	**29**
IV	15	**31.8**	2	2	1	3	4	28	7	**33**
Total	**58**	**123**	**9**	**9**	**10**	**30**	**12**	**84**	**31**	**123**

Mark Distribution

Cognitive Level	% Marks	Marks	TYPE OF QUESTIONS							
			PART A		PART B		PART C		TOTAL	
			No of Questions	Marks	No of Questions	Marks	No of Questions	Marks	No of Questions	Marks
R	30	**36.9**	9	9	4	12	2	14	15	**35**
U	50	**61.5**			6	18	6	42	12	**60**
A	20	**24.6**					4	28	4	**28**
Total	**100**	**123**	**9**	**9**	**10**	**30**	**12**	**84**	**31**	**123**