4012

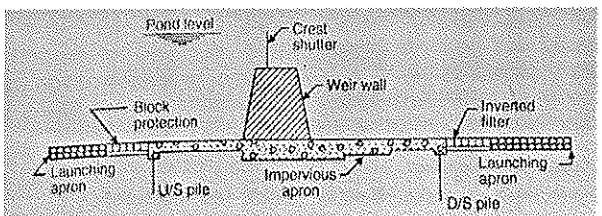
SCHEME OF VALUATION

(Scoring Indicators)

revision: 2015 Course Code :

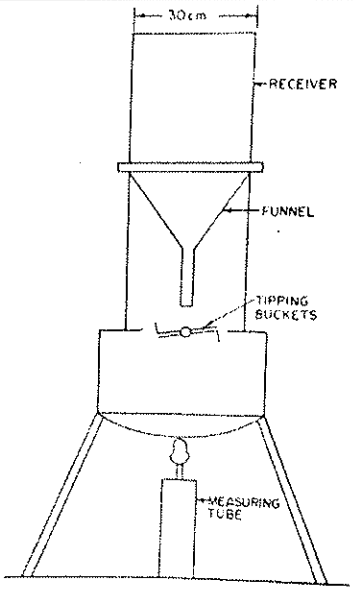
Course Title : IRRIGATION ENGINEERING

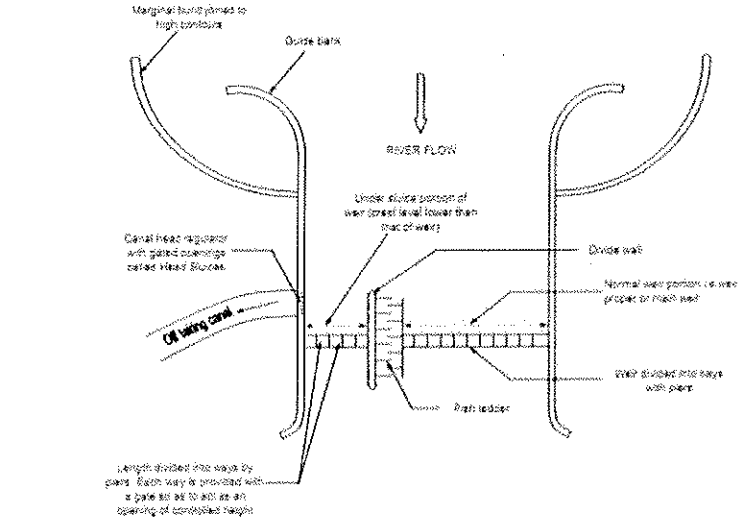
Qst. No.	Scoring Indicator	Split up score	Sub Total	Total
	PART – A			
I.1	1. Flow irrigation 2. Lift irrigation (well irrigation)	1 × 2	2	
I.2	weir is a solid construction places across the river. Its main function is to raise the water level so that the water can be diverted by canal to crop field due t difference of head	2	2	
I.3	Maximum Water Level-	2	2	10
I.4	Balancing depth- for a given cross section of canal there is always only one depth of cutting for which the cutting and filling will be equal. The depth is known as balancing depth.	2	2	
I.5	Soil erosion- when the top layer of fertile layer of soil is transported from one place to another place by a natural agency like wind, glacier or water, the phenomenon is called soil erosion. Due to soil erosion the land become unfertile.	2	2	
II.1	**Factors affecting run off** 1. Precipitation characteristics or pattern of rainfall 2. shape and size of catchment 3. Topography 4. Geological characteristics of basin 5. Meteorological characteristics 6. Orientation of watershed 7. Character of the catchment surface 8. Storage characteristics of the catchment (any six)	1 × 6	6	6
II.2	**Benefits of irrigation** 1. It gives good returns in the form of irrigation charges realized from cultivators 2. When irrigation facilities are available, valuable crops like sugarcane, cotton, paddy, etc. can be grown. 3. It prevents famines and improves the general conditions of the country. 4. New irrigation works are taken up at the time of famines to provide employment to the people. 5. Projects which are of multipurpose in nature can provide hydro electric power. 6. Irrigation canal provides navigation facilities also where	1 x 6	6	6

	possible 7. In some cases irrigation canals provide water supply for towns, villages that are there on the banks. 8. Irrigation helps in growing ornamental timber and fruits growing trees. (Any six)			
II.3	PARTS OF WEIR 1. Crest 2. Shutter 3. Weir wall 4. Launching apron 5. Impervious apron 6. Down stream piles 7. Upstream piles 8. Inverted filter 9. Block protection  FIG. 12.1. VERTICAL DROP WEIR.	6	6	6
II.4	Uplift pressure- When the percolating water exerts excessive upward pressure and when the apron is not sufficiently strong it may fail due to rupture. The upward pressure exerted by the percolating water is called uplift. Creep length – the water which percolates into the foundation creeps through the joint between the profile of the base of the weir and the sub soil. This total length covered by percolating water till it emerges out at the downstream end is called as creep length.	2 × 3	6	6
II.5	Forces acting on gravity dam 1. Water pressure 2. Self weight of the dam 3. Uplift pressure 4. Earth and silt pressure 5. Earthquake pressure 6. Ice pressure 7. Wind pressure 8. Wave pressure (Any six)	1 × 6	6	6
II.6	Selection of site for reservoir is based on the following points. a) Geological factors			

	b) Topographical factors c) Other miscellaneous factors **Geological factor** - Reservoir catchment must not have loose soil cover - Area of the reservoir should be far away from the earth quake epicenter - Reservoir bed should be impermeable and should not allow quick percolation of stored water - Soil in the reservoir area should not contain any type of harmful salts - Reservoir site should not be lying over an excessively faulted rock. **Topographical factors** - The reservoir basin should be wide above the dam site to facilitate more storage of water - The reservoir should have steep side slopes to provide maximum storage. - The basin of the reservoir should have narrow outlet which will reduce the cost of construction of the dam] **Other miscellaneous factors** - The reservoir occupation should not submerge valuable land and other properties - The reservoir site should not be too far away from the irrigable area - Catchment area of the reservoir should produce good and maximum runoff	2 2 2	6	6
II.7	Methods of preventing soil erosion a) Construct contour bunding b) Providing outlets and spillways so that the excess run off is allowed to escape c) Adopting mixed cropping and crop rotation d) Afforestation of catchment area is necessary e) Wind erosion can be prevented by growing trees (any 4)	1 ½ × 4	6	6
III.a	**PART – C** Duty – representsthe irrigating capacity of a unit of water expressed in hec/cumec. It is denoted by 'D'. Delta – the total depth of water required by a crop during the entire period the crop is in the field expressed in metre/milli metre/centimeters. It is denoted by the symbol Δ. Base period- base period for a crop refers to the whole period of cultivation from the time when the irrigation water is first issued for the preparation of the ground for planting the crop, to its last watering before harvesting. Crop period- crop period is the time , in days, that a crop takes	2×4	8	15

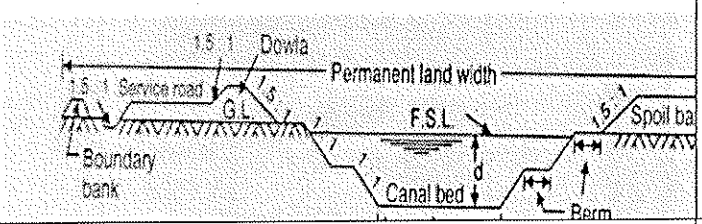
	from the instant of its sowing to that of its harvesting.			
III.b	Derivation- relation between duty, delta, and base period D = Duty in hectares/cumec Δ = total depth of water supplied (m) B = base period in days If we take a field of area D hectares, water supplied to the field corresponding to the water depth Δ metres will be = Δ× D hectare-metre = Δ× D× 10^4 cubic-metres (1) Again, for the same field of D hectares, one cumec of water is required to flow during the entire base period. Hence, water supplied to this field is = 1× (B ×24 ×60 ×60) cubic-metre (2) Equate (1) and (2) Δ× D× 10^4 = 1× (B ×24 ×60 ×60) Δ = 1× (B ×24 ×60 ×60)÷ D× 10^4 Δ = 8.64B/D metres	1 × 7	7	
IV.a	Flow irrigation – flow irrigation is that type of irrigation in which the supply of irrigation water available is at such a level that it is conveyed on to the land by the gravity flow. Flow irrigation may further be divided into two classes such as perennial irrigation system and inundation o flood irrigation system. Lift irrigation – lift irrigation is practiced when the water supply is at too low a level to run by gravitation on to the land. In such a circumstances water is lifted up by mechanical means. Irrigation from wells is an example of lift irrigation, in which sub-soil water is lifted up to the surface and is then conveyed to the agricultural fields.	4 4	8	
IV.b	<u>Tipping bucket type rain gauge</u> The tipping bucket type rain-gauge consists of 30 cm diameter sharp edge receiver. At the end of the receiver is provided a funnel. A pair of buckets are pivoted under the funnel in such a way that when one bucket receives 0.25 mm (0.01 inch) of precipitation it tips, discharging its contents into a reservoir bringing the other bucket under the funnel. Tipping of the bucket completes an electric circuit causing the movement of pen to mark on clock driven revolving drum which carries a record sheet.	4	7	15

		3		
V.a	1. Fish ladder – it consists of an inclined channel with a slope not exceeding 1 in 10. The compartment of bays of fish ladder should be sufficiently large so that the fish do not collide with the sides of the bay when ascending. Grooved gates are provided at the entrance and at the exit if the fish ladder for closing it. (figure) 2. Divide wall – divide wall is a long wall constructed at right angles to the weir or barrage. It may be constructed with stone masonry or cement concrete. On the upstream side the wall us extended just to cover the canal regulator and on the downstream side it is extended up to the launching apron. (figure)	2×4	8	
V.b	<u>Component parts of a diversion headworks</u> 1. Weir or barrage 2. Divide wall or divide groyne 3. Fish ladder 4. Under sluice or scouring sluice 5. Silt excluder 6. Canal head regulator 7. River training works such as marginal bund and guide banks			15

		7	7	
VI.a	i) Percolation – when a column of water is standing against the face of any irrigation structure and if the structure happens ti be one constructed on permeable foundations the water starts moving under the foundations with certain amount of pressure. This movement is called as percolation. ii) Scour- scour has a bad effect on any irrigation work. Since a weir is constructed on a permeable foundation it has to give scope for the percolating water to flow under its foundation also. If proper length of creep and the relevant protective works are not provided under the weir floor the water percolating may try to re appear at any point. Since this percolating water has certain amount of pressure its re appearance may cause scour. To provide sufficient protection against this scouring effect a correct length of creep is to be provided and protective works like solid aprons or loose aprons are to be constructed along the length of the creep.	2 × 4	8	15
VI.b	Effect of percolation and their protective work: 1. Failure due to piping water from the upstream side continuously percolates through the bottom of the foundation and emerges at the downstream end of the weir or barrage floor. The force of percolating water removes the soil particles by scouring at the point of emergence. As the process of removal of soil particles goes on continuously, a depression is formed which extends backwards towards the upstream through the bottom of the foundation. A hollow pipe like formation thus develops under the foundation due to which the weir or barrage may fail by subsiding. This phenomenon is known as failure by piping or undermining. 2. Rupture of floor due to uplift. It will create an uplift pressure on the structure and topple the structure at any moment. To avoid this, protective	2 × 2	7	

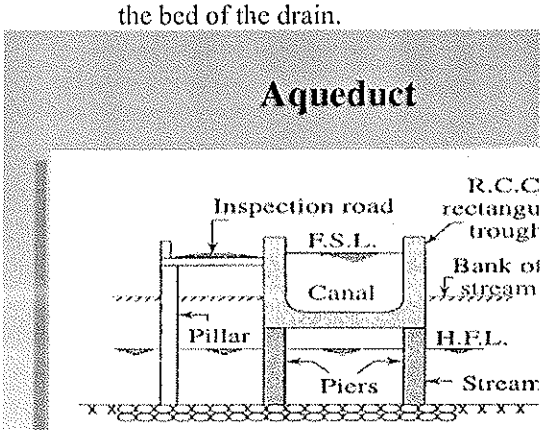
	works have to be provided on both U/S and D/S sides. Protective works: 1. Upstream stone pitching 2. Upstream Apron 3. Upstream Curtain Wall 4. Downstream Apron 5. Downstream Curtain Wall 6. Protective blocks	3		
VII.a	Types of dam according to the material used in construction 1. Rigid dam: constructed of rigid material. – Timber dam – Steel dam – Arch dam – Buttress dam – Solid gravity dam 2. Non rigid dam: constructed of non rigid material. – Rock fill dam – Rock and earth fill dam – Earth dam	2×4	8	
VII.b	**<u>Forces acting on a gravity dam</u>** 1. Water pressure: • it is the pressure of the water on the upstream side of the dam. • This is the largest external pressure causing the instability of the dam structure. • The total water pressure is in horizontal direction and acts on the upstream side at a height of **H/3 from the bottom** • The pressure diagram is a triangle and the total pressure is given by **$P = WH^2/2$** 2. Self weight of the dam: • The self weight of the dam is the only largest force which stabilizes the structure. • The total weight of the dam acts at the centre of gravity of its section 3. Uplift pressure: • When the water is stored on the upstream side of a dam there exists a head of water equal to the height up to which the water is stored. This water seeps through the foundation of the dam or through the body of the dam and causes upward pressure. This upward pressure is known as uplift pressure. • This uplift pressure reduces the effective weight of the structure. • Uplift pressure U = ½*wH* B 4. Earth and silt pressure: i. The upstream river brings silt and debris along with it. It is then deposited when the		7	15

	dam is constructed. Therefore the dam is subjected to silt pressure in addition to water pressure. 5. Ice pressure: ice pressure is more important for dams constructed in cold countries or at higher elevations. The ice formed on the water surface of the reservoir is subjected ti expansion and contraction due to variation in temperature. This force acts linearly along the length of the dam. Its magnitude varies from 0.25 to 1.5 N/mm2. 6. Wind pressure – it is minor force and need hardly take into account for the design of dams. Wind pressure is required to be considered only on that portion of the super structure which is exposed to the action of wind. Normally it is taken as 1000 to 1500 N/m2 for the area exposed to wind pressure. 7. Wave pressure – the upper portion of the dam is subjected to impact of waves by blowing wind. The wave pressure depends on the extends of the water surface.	7		
VIII.a	**Types of dams** • According to use 1. Storage dam - Constructed to store water during the rainy season, when water is available in the river - Release gradually for intended purposes - They may store water for hydro electric power generation irrigation or for water supply. 2. Diversion dam - Used to raise the water level and divert water - No reservoir is formed - No or a little storage 3. Detention dam - Flood mitigation - Store water in the time of flood and release water after flood at safe rate.	8	8	15
VIII.b	Tank sluice- tank sluice is an opening in the form of a culvert or pipe running through or under the tank bund, and supplying water from the tank to the distributary channel below, to meet the irrigation or other water requirements, as and when needed. Flush escape- canal escape is a structure to dispose of surplus or excess water from a canal. Flush escape is one of the classifications of the canal escape based on the structural design. These are flush or weir escapes constructed either in masonry or concrete with or without crust	3 ½ × 2	7	

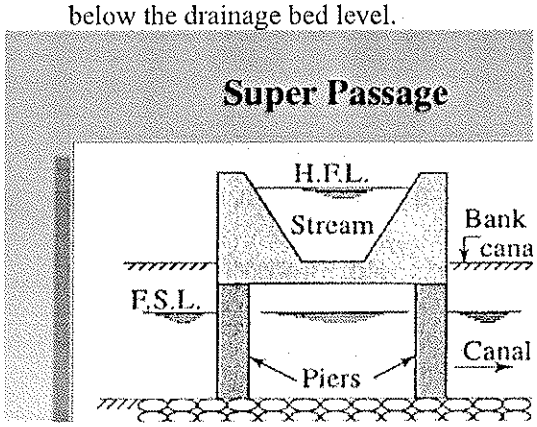
	shutter which are capable of disposing of surplus water from the canal			
IX.a	(i) spoil bank – when the quantity of earth obtained from excavation or cutting is deposited near the cutting in the form of bank known as spoil bank (ii) canal lining - it is the treatment given to the canal bed and banks to make the canal section impervious. The canal lining is used to reduce the seepage loss of irrigation water by adding an impermeable layer to the edges of the trenches. (iii) berm. – this is the horizontal distance which is left at ground level between the top edge of cutting and toe of bank. When the water flows in the canal at F.S.L (full supply level) silt particles are deposited in the berms and make the final side slope to 1.5: 1 (iv) Saturation gradient- when the water is impounded on the upstream side of an earth dam there is a head of water equal to the height of the water stored. Under this head water seeps or percolate towards the downstream side and it loses the head enroute. The head of the water goes on decreasing towards the downstream side and touches the base at some point. Thus saturation line is the line of demarcation between saturated soil and unsaturated soil in the dam section. The slope of this saturation line is called as saturation gradient.	2×4	8	15
IX.b	Cross-section of canal:-  	7	7	
X.a	**Cross drainage works** An irrigation work built for crossing the canal water safely over or under the natural drain is termed as cross drainage works. Types of cross drainage works are			

1. Aqueduct
2. Siphon aqueduct
3. Super passage
4. Siphon super passage
5. Level crossing
6. Inlet and outlet

1. Aqueduct- the irrigation work constructed for passing the canal water over the drainage is called as an aqueduct. In this the canal bed level is sufficiently at a higher level above that of the MFL of the drain so that the drain water may easily pass through the culvert under the canal without dropping the bed of the drain.



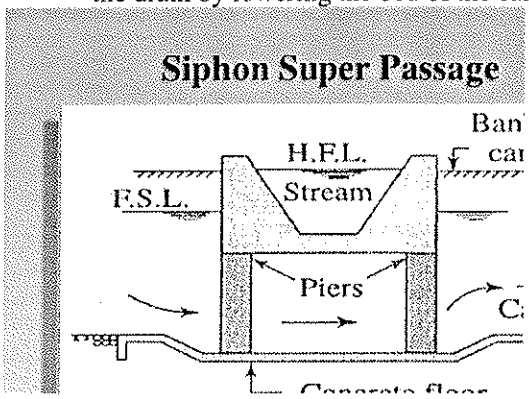
2. Siphon aqueduct – the types of C.Dwork is necessitated when the H.F.L of the drainage touched the canal bed level. To provide a greater clearance and also a quicker discharge the bed of the drainage is depressed below the crossing to form an inverted siphon.
3. Super passage – this is a cross drainage work where the drain passes over the canal without lowering the bed of the canal. In this case the F.S.L if the canal is sufficiently below the drainage bed level.



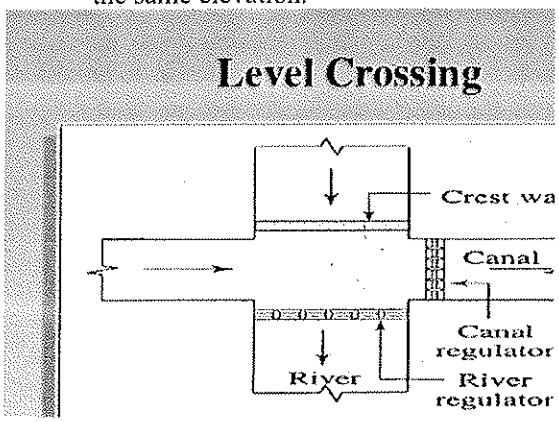
4. Siphon super passage – this C.D work also similar to that of a super passage where canal flows under

		2 × 4	8	15

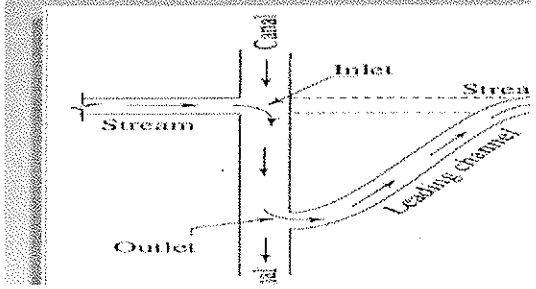
the drain. If the F.S.L of the canal is not sufficiently below the bed level of drainage, the water of canal is to be siphoned through the drain by lowering the bed of the canal.



5. Level crossing – this type of cross drainage work is constructed when the bed level of the canal and that of the drainage meet at the same elevation.



6. Inlet and outlet- inlet is constructed in the canal bank to admit water from the drain in to it if the discharge is less and free from the silt particle. The silt of the inlet is fixed at F.S.L of the canal. Outlet is provided to dispose of the surplus water entering the canal. The sides of the canal and bed of the canal must be protected by stone pitching.

	Inlet and Outlet  (any 2 with figure)			
X.b	**Soil erosion** Causes of soil erosion i. Natural- some portion of soil gets eroded naturally and carried away by the action of water and wind. a) Water erosion-water erosion is due to beating of rain water flowing high velocity on the land surface. there are two types of water erosion sheet erosion and gully erosion. In sheet erosion a thin sheet of soil is washed away. b) Wind erosion ii. Artificial- deforestation and over grazing, faulty method of cultivation are the artificial causes of soil erosion. iii. Man made Effect of soil erosion • The following are the some of the ill effects of soil erosion 1. As the fertile top soil is eroded, the crop nutrients are lost and crop growth is adversely affected. 2. The land becomes barren 3. As run-off water comes down heavily during rainy season from catchments sudden and heavy floods occur causing heavy loss to the crops, life and property in plains below. 4. As there is no check on erosion, water percolation is prevented, thus depleting the ground water	7	7	