SCHEME OF VALUATION

Revision (15) 4012Course title:**Irrigation Engineering**

| Qst. No. | Scoring indicator | Split up score | Sub Total | Total |
|---|---|---|---|---|
| I (1) | **PART A**<br>Symon's rain gauge, Weighing bucket rain gauge, Tipping bucket rain gauge, Float type rain gauge | 0.5 x 4 | 2 | 2 |
| I (2) | The movement of water through any irrigation structures having permeable foundations is known as percolation. | 2 | 2 | 2 |
| I (3) | Sodium carbonate lining, Asphaltic lining, Shotcrete lining, Brick lining, Precast concrete block lining, Cement mortar lining, Cement concrete lining, Stone masonry lining. | 0.25 x 8 | 2 | 2 |
| I (4) | A berm is a horizontal spacing given in between cutting and embankment or in between two embankments or in between two cuttings. | 2 | 2 | 2 |
| I (5) | • Ogee spillway<br>• Drop spillway<br>• Siphon spillway<br>• Chute spillway<br>• Shaft spillway<br>• Side channel spillway | 2 | 2 | 2 |
| II (1) | **PART B**<br>Factors affecting duty are:<br>• Rainfall<br>• Evaporation<br>• Base period of a crop<br>• Soil characteristics<br>• Type of crop<br>• Method of cultivation<br>• Quality of water<br>• Topography of land | Any 6 pointswith brief explanation – one mark each | 6 | 6 |

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<td>II<br>(2)</td>
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<tr><th>Sl. No.</th><th>Weir</th><th>Barrage</th></tr>
<tr><td>1</td><td>Raised concrete wall constructed across the river</td><td>Low concrete walls</td></tr>
<tr><td>2</td><td>Provided with small gates on its top</td><td>Provided with high gates</td></tr>
<tr><td>3</td><td>Most of the ponding is done by conrete wall and very little by the gates</td><td>Most of the ponding is done by gates and very little by the conrete wall</td></tr>
<tr><td>4</td><td>No control over water level</td><td>Better control over water level by opening and closing the gates</td></tr>
<tr><td>5</td><td>Large amount of silt deposition occurs</td><td>No silting problem</td></tr>
<tr><td>6</td><td>Shorter construction period</td><td>Longer construction period</td></tr>
<tr><td>7</td><td>Less costly</td><td>More costly</td></tr>
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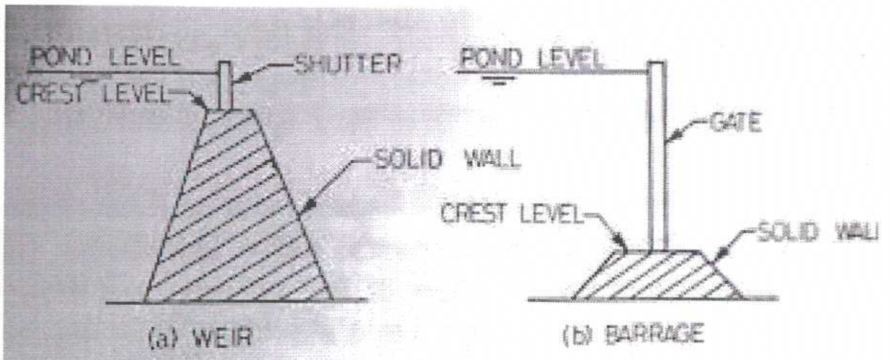

Fig.17·2
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<td>Any 5 points – 1 mark each<br><br>Fig. - 1 mark</td>
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<td>II<br>(3)</td>
<td>Forces acting on a gravity dam are:

- Water pressure
- Weight of dam
- Uplift pressure
- Earthquake Forces
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| | <ul><li>Ice pressure</li><li>Wave pressure</li><li>Silt pressure</li><li>Wind pressure</li></ul>(List out all the forces and briefly explain each one) | | | |
| II (4) | Classification based on the nature of source of supply:-<br><br>**1. Permanent Canal 2. Inundation Canal**<br><br>Classification based on the financial output:-<br><br>**1. Productive Canal 2. Protective Canal**<br><br>Classification based on function of the canal:-<br><br>**1. Irrigation Canal 2.Carrier Canal 3. Feeder Canal**<br><br>**4. Navigation Canal 5. Power Canal**<br><br>Classification based on discharge and its relative importance in a given network of canal:-<br><br>**1. Main Canal 2. Branch Canal 3. Major Distributary**<br>**4. Minor Distributary 5. Water Course**<br><br>Classification based on Canal Alignment:-<br><br>**1. Contour Canal 2. Watershed Canal (Ridge Canal)**<br><br>**3. Side Slope Canal** | List out all classifications – 6 marks | 6 | 6 |
| II (5) | Irrigation may be defined as the supply of water by artificial methods to the fields for cultivating the crops.<br><br>Necessity of irrigation: The necessity of irrigation depends upon following points: | Definition - 2marks<br><br>Necessity - 4marks | 6 | 6 |

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| | a) Less Rainfall<br>b) Non-uniform Rainfall<br>c) Growing a number of crops during a year<br>d) Growing perennial crops<br>e) Commercial Crops with additional water<br>f) Controlled water supply<br>(Briefly explain each) | | | |
| II (6) | 1. The river section at the site should be narrow and well-defined.<br>2.The river should have high, well-defined, in erodible and non-submersible banks so that the cost of river training works is minimum.<br>3.There should be suitable arrangement for the diversion of river during construction.<br>4. The site should be such that the headwork can be aligned at right angles to the direction of flow in the river.<br>5. There should be suitable locations for the under sluices, head regulator and other components of the diversion head works.<br>6. The canals taking off from the diversion head works should be quite economical and should have a large commanded area.<br>7. Good foundation should be available at the site.<br>8. The required materials of construction should be available near the site.<br>9. The site should be easily accessible by road or rail.<br>10. The overall cost of the project should be a minimum. | Any six points – 6 marks each | 6 | 6 |
| II (7) | When the water is stored on the upstream side of an earth dam, the head of | 3 marks each | 6 | 6 |

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| | water there will be equal to the height of water stored. Under this head, water seeps in and percolates through the body of the dam. As this water proceeds downstream side, it loses head. The head of water goes on decreasing towards downstream end 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 ***saturation gradient***.<br><br>The top flow line of a saturated soil mass below which seepage takes place, is called the **Phreatic line**. This line separates a saturated soil mass from an unsaturated soil mass. It is defined as an imaginary line within the dam section, below which there is positive hydrostatic pressure, and above which there is negative hydrostatic pressure in the dam section. Phreatic line is also known as the seepage line or saturation line. | | | |
| III<br>(a) | **UNIT I**<br>• **Duty** of a water simply expresses the number of hectare of land that can be irrigated for the full growth of the given **crop** by supplying 1 cumec water continuously during the entire base period of that **crop**. It is generally represented by 'D'. Its unit is hectare/cumec.<br>• **Delta** is the total depth of water required by a crop during the entire crop period and is denoted by thesymbol $\Delta$.<br>• The time period that elapses from the instant of its sowing to the instant of its harvesting is called the **Crop-period.**<br>• The time between the first watering of a crop at the time of its sowing to its last watering before harvesting is called the **Base period.**<br>• Crop period is slightly more than the base period, but for all practical purposes, they are taken as one and the same thing, and generally expressed as B days. | 2 x 4 = 8 | 8 | 15 |
| III<br>(b) | D = duty in hectares/cumec<br><br>$\Delta$ = total depth of water supplied in metres<br><br>B = base period in days | Eqn (1) and Eqn (2) – two marks each | 7 | |

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| | If we take a field of area D hectares, water supplied to the field corresponding to the water depth Δ metres will be = Δ x D hectares-metres.<br>$=D\times\Delta\times10^4$ cubic-metres. .... (1)<br>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.<br>$=(1)\times(B\times24\times60\times60)m^3$ .... (2)<br>Equating Equations (1) and (2), we get<br>$D\times\Delta\times10^4=B\times24\times60\times60$<br>$\Delta=(B\times24\times60\times60)/(D\times104)=8.64B/D metres.$<br>$$D=\frac{8\cdot64B}{\Delta}$$ | Equating both – 2marks<br><br>Final eqn - 1mark | | |
| IV (a) | Factors affecting runoff are:<br>• Pattern of rainfall<br>• Character of catchment surface<br>• Topography<br>• Shape and size of catchment area<br>• Vegetation in the catchment area<br>• Geological features of the area<br>• Meteorological conditions<br>(Briefly explain each) | Any 6 points – 1mark each | 6 | 15 |
| IV (b) | • Measurement of velocity by floats<br>• Measurement of velocity by velocity rods<br>• Measurement of velocity by current meters<br>(Explain each) | 3 x 3 | 9 | |
| V (a) | **Scouring sluices -** The construction of a weir (or barrage) across a river results in ponding of water, and causes considerable sediment deposition just upstream of the canal head regulator. This sediment must be flushed | 3.5 x 2 | 7 | 15 |

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| | downstream of the weir. This is done by means of scouring sluices (also known as under sluices). The under sluices are the openings provided at the base of the weir or barrage. These openings are provided with adjustable gates. Normally, the gates are kept closed. The suspended silt goes on depositing in front of the canal head regulator. When the silt deposition becomes appreciable the gates are opened.<br>**Head regulator -** A structure which is constructed at the head of the canal to regulate flow of water in the off taking canal is known as canal head regulator. It consists of a number of piers which divide the total width of the canal into a number of spans which are known as bays. The span between the piers is usually kept between 8 to 12 m for large canal. They are operated by gates provided for regulation of flow into the canal. The crest level is usually kept higher than that of the under sluices. The gates are operated form the top by suitable mechanical device. A platform is provided on the top of the piers for the facility of operating the gates. | | |
| V (b) | The **divide wall** is a long wall constructed at right angles in the weir or barrage, it may be constructed with stone masonry or cement concrete. The wall extends on both sides of the weir. The divide wall separates the weir floor from the floor of the scouring sluices which is usually at a lower level than the weir floor. The divide wall also isolates the canal head regulator from the main river flow, and creates a still pond of water in front of the canal head regulator. This results in relatively sediment- free water entering into the off taking canal. On the upstream side, the wall is extended just to cover the canal head regulator and on the downstream side, it is extended up to the launching apron.<br><br>The **fish ladder** is provided just by the side of the divide wall for the free movement of fishes. The tendency of fish is to move from upstream to downstream in winters and from downstream to upstream in monsoons. This movement is essential for their survival. Due to construction of weir or barrage, this movement gets obstructed, and is detrimental to the fishes. While constructing a weir across a river, a narrow opening between the divide wall and the scouring sluices (where water is always present) is | 4 x 2 | 8 |

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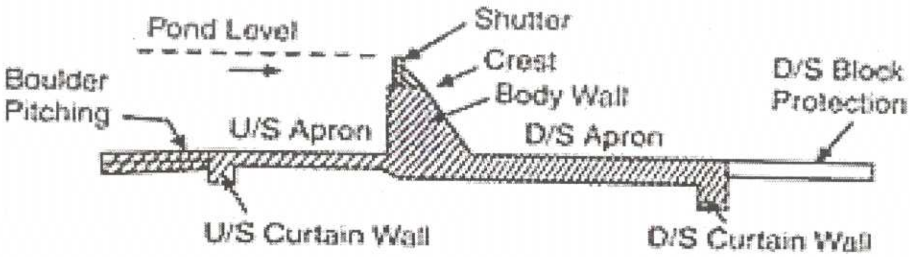
| | provided to allow for free movement of fish. This opening is called fish ladder or fish way or fish pass. In the fish ladder, the fable walls are constructed in a zig-zag manner so that the velocity of flow within the ladder does not exceed 3 m/sec so that fish can easily travel upstream. The width, length and height of the fish ladder depend on the nature of the river and the type of the weir or barrage. | | | |
| VI (a) | <br><br>Fig. 12.5. Parts of weir<br>Component parts of a weir are:<br>• Body of the weir<br>• Upstream apron<br>• Upstream curtain wall<br>• Downstream apron<br>• Downstream curtain wall<br>• Crest<br>• Shutters or gates | Fig. - 2marks<br><br>Listing out the components - 1mark<br><br>Explanation – 4 marks | 7 | 15 |
| VI (b) | Any hydraulic structure which supplies water to the off-taking canal is called a headwork.<br><br>Headworks are classified into: 1.Storage head works 2.Diversion head works.<br><br>Diversion works can be classified under following two heads: 1. Temporary bunds or spurs 2. Permanent weirs and barrages | Definition – 2marks<br><br>Classification - 6marks | 8 | |
| VII (a) | The main causes of failure of earth dams are: | 3 x 3 | 9 | 15 |

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- Hydraulic Failures
- Seepage failures
- Structural Failures

(Explain each)
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<td>VII<br>(b)</td>
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Based on the limiting height, the dams can be classified into *low gravity dam and high gravity dam.* Thus, the limiting height defines the distinction between a low and high gravity dam.

If the height of a dam is less than that given by the equation of limiting height, then it is known as a ***Low Gravity Dam.*** Here, the maximum compressive stress will be less than the allowable stress.

If the height of a dam is more than that given by the equation of limiting height, then it is known as a ***High Gravity Dam.*** Here, the maximum stress will exceed the allowable stress. Hence the section will have to be given extra slopes on the upstream and downstream sides below the limiting height to bring the compressive stress within the limits.
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<td>3 x 2</td>
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<td>VIII<br>(a)</td>
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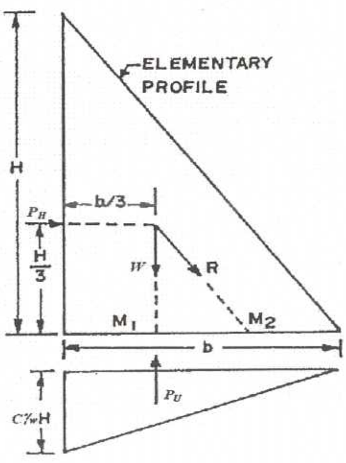
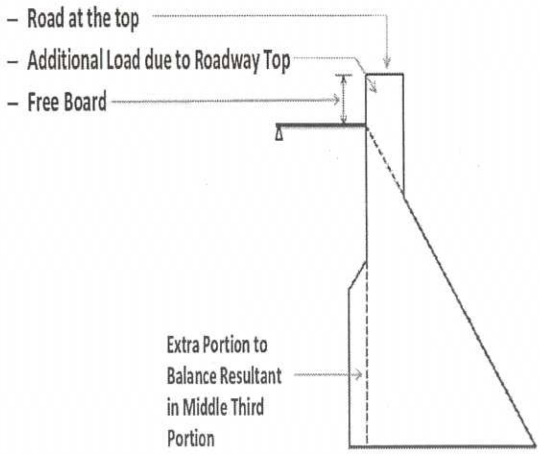
In the absence of any force other than the forces due to water, an elementary profile will be triangular in section, having zero width at the water level where hydrostatic pressure is zero, and maximum width at the base where maximum hydrostatic pressure head acts. The increasing width of the section towards the base is logical since the water pressure also increases linearly with depth.



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<td>Figure of both profiles – 1.5marks each<br><br>Explanation of both profiles - 3marks each</td>
<td>9</td>
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| | The elementary profile of the gravity dam is only a theoretical profile. Such a profile is not possible in practice because we have to make provision for (i)Freebord (ii)Roadway at the top (iii)Additional loads due to the roadway. Hence the practical profile will be different from the theoretical profile. Due to the provision of the above three, the resultant will act outside the outer middle third and tension will occur. To eliminate this tension, some extra concrete is provided in the upstream side of the dam. | | | |
| VIII (b) | A gallery is an opening provided in a dam in the longitudinal direction of the dam. It provides access to the interior of the dam. The shape and size varies from dam to dam depending upon the functions it has to perform. The gallery is usually rectangular in shape with its top and bottom either flat or semi-circular. The width of gallery generally varies from 1.5 to 1.8 m. The height of the gallery is between 2.2m to 2.4 m, so that a person can easily walk inside it.<br><br>***Functions:***To provide drainage of the dam section. To provide space for equipments required for drilling holes and grouting the hole. A gallery provide an access to the interior of the dam for inspection and maintenance. A Gallery also provides space for installing various instruments in the dam to study its structural behaviour. A gallery can provide space for the mechanical and electrical equipment required for the operation of gates for spillways and outlets. | Fig. - 1mark<br>Explanation – 3 marks<br>Functions – 2 marks | 6 | |
| IX (a) | **Type I** (Canal passes over the drainage) (HFL < FSL)<br>(a) Aqueduct (b) Siphon Aqueduct<br>**Type II** (Drainage passes over the canal) (HFL > FSL)<br>(a) Super passage (b) Canal Siphon<br>**Type III** (Drainage and canal intersect each other at the same level)<br>(a) Level crossing (b) Inlet and outlet<br>(Explain any three) | 3 x 3 | 9 | 15 |
| IX | The canal section is considered to be most economical when cutting at a | 3 x 2 | 6 | |

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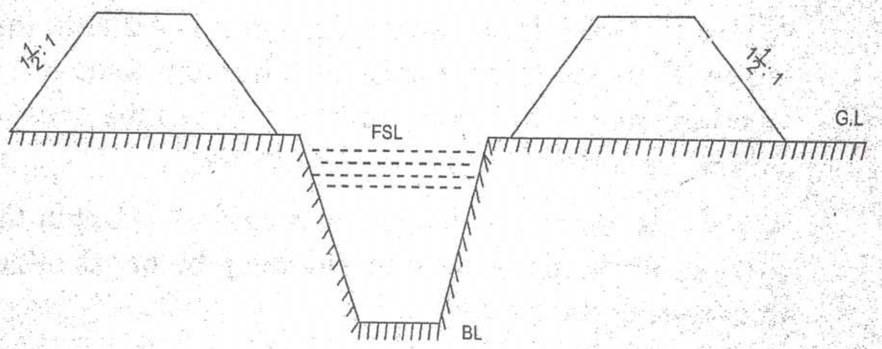
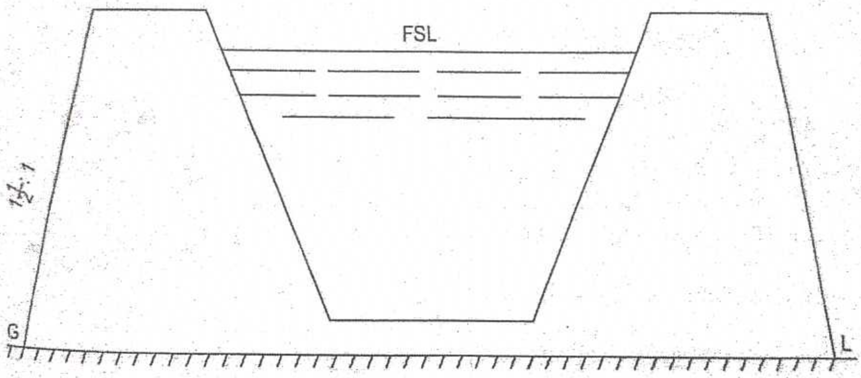
| (b) | particular section equals the filling. For such a section payment has to be made only for one operation. Moreover the formation of borrow pits, or spoil banks is completely eliminated. This particular depth is known as balanced depth of cutting.<br><br>A channel is said to in regime, if there is neither silting nor scouring".<br><br>According to Lacey there may be three regime condition as:<br><br>(i) True regime (ii) Initial regime (iii) Final regime | | | |
| X<br>(a) | <br><br>Fig. 4.3 (b) Canal in Full Cutting<br><br><br><br>Fig. 4.3 (c) Canal in Full Banking | 2 x 3 | 6 | 15 |

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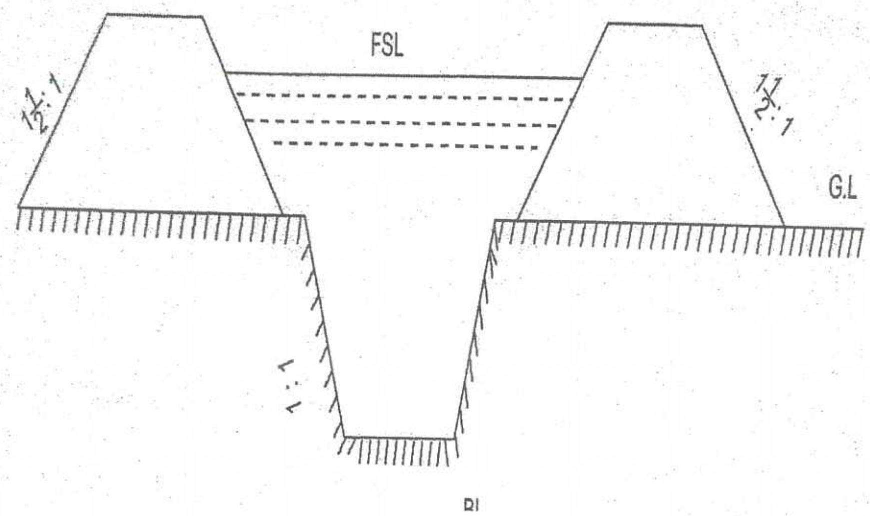
| |  | | | |
| X (b) | **1. Main Canal –** This canal takes off directly from a river or reservoir. It is generally very big. Being too big, direct irrigation is generally not done from it except in exceptional circumstances. It acts as a carrier to feed branch canals or major distributaries.<br><br>**2. Branch Canal -** These are branches of the main canal. They derive supplies from the main canal. Branches also carry quite large discharges and as such direct outlets should be given to lonely higher spots only lying along the alignment which cannot be irrigated from the distributaries.<br><br>**3. Major Distributaries –** This canal takes off from a branch canal and distributes water to specified area. Size of these canals are small as their carrying capacity is only 0.5 to 5 cumecs. They supply water to minor distributaries.<br><br>**4. Minor Distributaries –** They are smaller in section. Derive water from major distributaries and supply water to field channels discharging capacity is less than 0.5 cumecs<br><br>**5. Water Courses –** These are very small channels which are constructed and maintained by the cultivators themselves. These channels derive supplies from the minor distributaries through outets and spreads the water on the field. | 9 | 9 | |