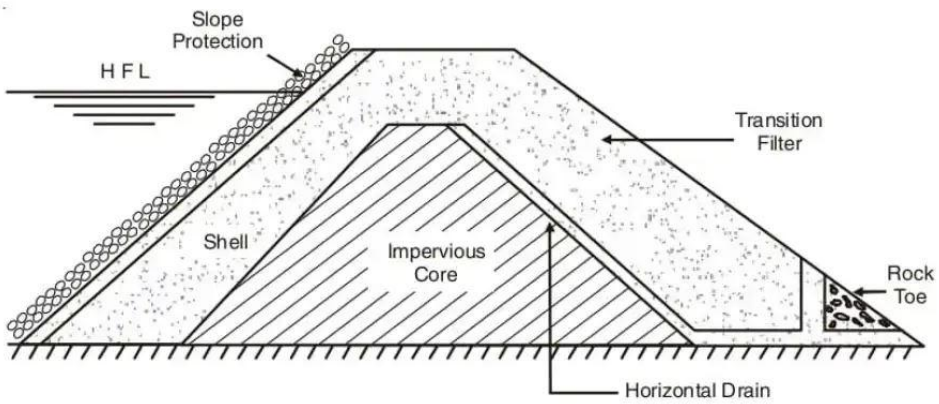
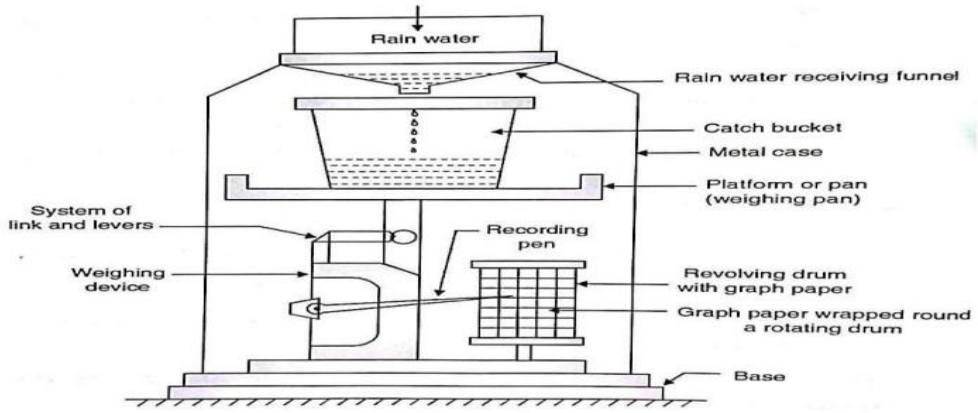
Important Instructions to examiners:

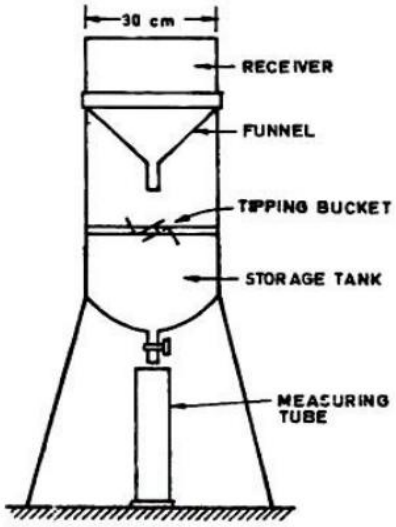
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 candidate and 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 model answer.
6) In case of some questions credit may be given by judgement 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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
Q-1		**Attempt any FIVE of the following:**	**10 M**
	a)	**State any four benefits of Irrigation.**	02
	Ans.	Following are the benefits of irrigation: – 1) Increase in food production 2) Protection from famine 3) Cultivation of cash crops 4) Flood control 5) Generation of Hydro-electric power 6) Domestic & industrial water supply 7) Inland navigation 8) Increase in revenue to the government 9) Increase in communication 10) Canal plantation 11) Improvement in ground water storage 12) Aid in civilization	2 M (1/2 Each)
	b)	**Define Yield and Dependable yield.**	**02**
	Ans.	**Yield:** It is the total quantity of water available from a catchment area at the outlet in period of one year. **Dependable yield:** It is the quantity of water available for a given number of years per rainfall cycle.	1M 1M

	c)	**Define Base period and Crop period.**	**02**
	Ans.	**Base period:** It is the period in days from first watering at the time of sowing to the last watering before harvesting. **Crop period:** It is the period in number of days that crop takes from the instant of its sowing to that of its harvesting.	1M 1M

	d)	**Enlist any four methods of assessment of irrigation water.**	**02**
	Ans.	**Methods of assessment:** 1) Volumetric assessment 2) Assessment on area basis 3) Assessment on seasonal basis 4) Composite rate 5) Permanent assessment	2M 1/2 each (any four**)**
	e)	**Enlist any four functions of spillway**.	**02**
	Ans.	1. To effectively dispose off the surplus quantity of water from upstream to downstream side of the reservoir. 2. To control the discharge from reservoir. 3. To avoid overtopping of surplus water. 4. To protect downstream slope from scouring and erosion.	02 ½ M Each
	f)	**Draw a neat sketch of zoned type earthen dam.**	**02**
	Ans.	 Fig. - **Zoned type earthen dam**	1 marks for labeling 1 marks for neat sketch
	g)	**State any two advantages of Bandhara Irrigation.**	**02**
	Ans.	**Advantages of bandhara irrigation:** a. The system of irrigation is economical b. Maximum utilization of water. c. The length of canal and distribution system is small, hence water losses are very less. d. The area to be irrigated is close to the source, hence duty and intensity of irrigation is high. e. Ease in construction	2M (1 M Each)

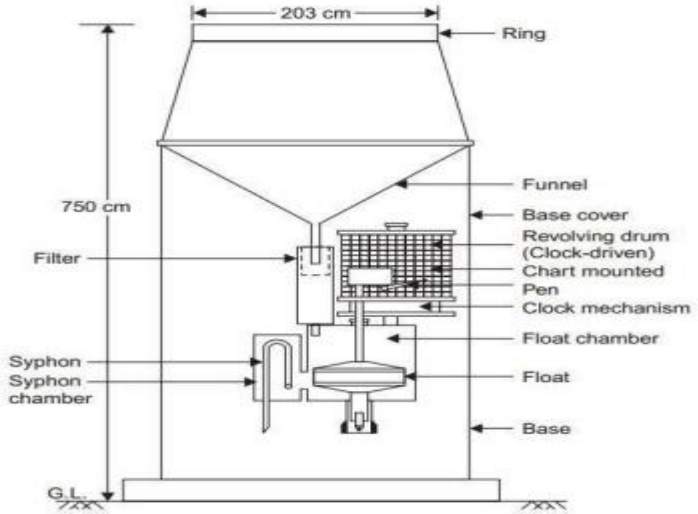
Q-2		Attempt any THREE of the following:	12 M
	a)	**Define Rainfall. Explain with neat sketch automatic rain gauge.**	4
	Ans.	**Rainfall:** Rainfall is the depth in mm or cm of water that would stand on the surface of the earth provided it were not lost by evaporation or absorption or any other manner. **Types of automatic rain gauges:** 1) Weighing bucket gauge 2) Tipping bucket gauge 3) Syphon gauge (Float type rain gauge) **Weighing type rain gauge**: 1.The rain water passes through a funnel into a bucket called as catch bucket which is placed on weighing platform. 2.When weight of bucket is increased due to rain water the weighing platform moves. Movement of weighing platform is transmitted to Links and levers to a pen arm. This pen traces the collected amount of rainfall on a graduated graph paper wrapped around drum. 3. Thus increasing weight of the bucket helps in recording the rainfall with time by moving a pen on a revolving drum.  **Fig. Weighing type rain gauge** **OR** **Tipping Bucket type rain gauge :** 1. A Steven's tipping bucket type rain gauge consist of 30 cm dia. Sharp edge receiver 2. End of the receiver is provided with funnel. A pair of bucket is provided under the funnel in such a way that one bucket receives 0.25 mm of precipitation .it tips, discharging its content to container brining the other bucket the funnel. 3. Tipping of the bucket completes an electric circuit causing movement of pen to mark on clock driven revolving drum which carries a record sheet. 4. The electric pulses are generated due to tipping of bucket is recorded at the control room far away from the rain gauge station.	1 M 1M- Explainatio n of any one rain gauge. 2M- For fig of res. Rain gauge statiom



OR

Float type Automatic rain gauge :

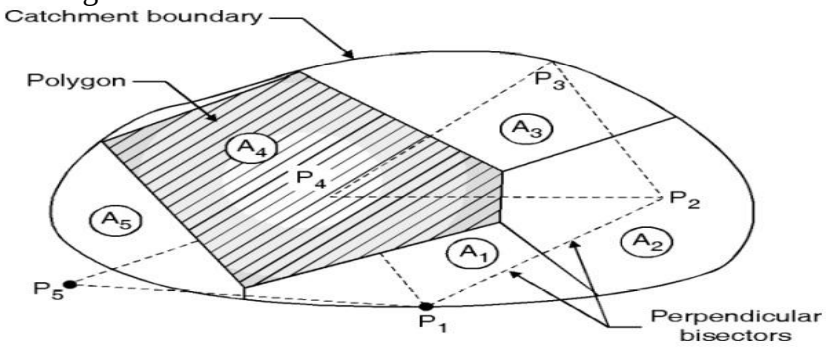
1. The funnel receives rain water which is collected in rectangular container.
2. A float is provided at the bottom of the container.
3. The float is raise as the water level rises in the container, its movement being recorded by a pen moving on a recording drum actuated by the clock work. When the water level in the container rises so that siphons come into operation and releases water. Thus all the water in the box is drain out.

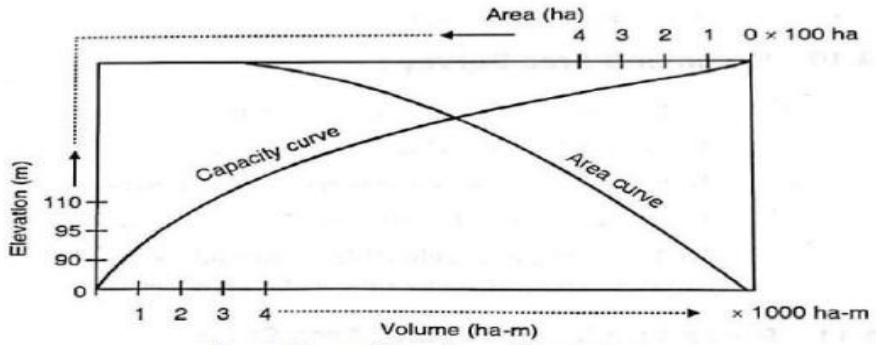


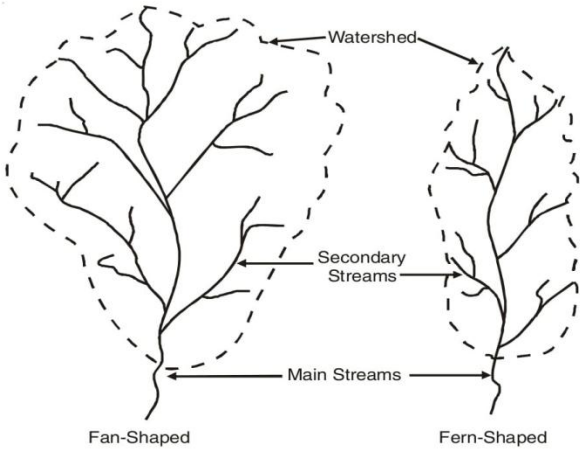
Float type rain gauge

(Note: Explanation for any type mentioned above should be considered)

	b)	**Define computation of rainfall. Describe thiessans polygon method with suitable sketch.**	**4**
	Ans .	Definition: Measurement of height of water (in mm or cm) stands over the surface of earth for particular duration of time is called computation of Rainfall. **(Note: for any appropriate definition , give full marks)**	1M

		Thiessen's polygon method is used for determining average rainfall of catchment. In this method, rainfall recorded by each station is weighed according to the area. It is also known as weighed mean method. It is more accurate than the arithmetic mean method. Consider rain gauge stations A, B, C, and D representing the area as shown in figure.  1) Join the adjacent rain gauge stations A, B, C, and D by straight lines. 2) Construct the perpendicular bisectors of each of these lines. 3) A Thiessen's network is thus constructed. Each polygon contains rain gauge station. It is assumed that the entire area within any polygon is nearer to the rain gauge station that is included in the polygon. 4) Find the area of each polygon shown hatched in the figure. 5) Multiply the area of each polygon by the rain gauge value of the enclosed figure. 6) Find the total area. (ΣA) of the basin. 7) Compute the average precipitation or rainfall from the equation Let, A1, A2, -------An = Area P1, P2, --------Pn = Average rainfall of that station $P=\frac{A_1P_1 + A_2P_2 + A_3P_3 \ldots + A_nP_n}{A_1+A_2+---- +A_n} = \frac{\sum A \times P}{\sum A}$	1 M- Fig 2 M - Explanation
	c)	**Define silting of reservoir. State factors affecting the rate of silting.**	4
	Ans.	**Silting of reservoir:** Silting of reservoir means the deposition of silt and clay i.e. fine particles of soil in reservoir. **Factor affecting silting in a reservoir are as follows:** 1) Catchment area: If catchment area is more, silting will be more. If catchment area is less, silting will be less. 2) Shape of catchment: If catchment area is fan shaped, silting will be more. If catchment area is fern shaped, silting will be less. 3) Slope of country: If slope is steep, more particles will be erodes because of high velocity of runoff & will be deposited in reservoir basin and vice versa. 4) Climatic condition: Dry and rainy climate helps in production of more silt material. 5) Nature of surface soil: If soil is weathered or loose it can be easily flow with runoff and deposited in reservoir.	1M 3M (1 M for each)

	d)	**Draw a neat sketch of area capacity curve. Describe how to interpret various parameters from this curve.**	4
	Ans.	 Area-Capacity elevation curve From the contour plan of reservoir site the areas of the successive contour A_1, A_2 ,….,A_n are determine with the help of planimeter. The area A1 is the minimum at the bottom of the basin and is the maximum area at the top of basin. This curve gives the area submerged at different elevations. Uses of area capacity curve: 1) To decide capacity of reservoir 2) To know water spread area of reservoir 3) To find out elevation (RL) for any capacity 4) To fix control levels of dam	2M- For fig 2M- Explaination
Q-3		**Attempt any THREE of the following:**	**12 M**
	a.	**Define runoff. State the various factors affecting runoff.**	**04**
	Ans	**Runoff:** The portion of rainfall water which flows over the ground surface after all losses have been taken place is known as runoff. It is expressed in mm or cm. Runoff = Rainfall – Losses **Factors affecting on runoff :** Following are the various factors affecting on runoff, 1. **Intensity of rainfall:** If Intensity of rainfall is more, runoff will be more and vice versa. 2. **Topography of the catchment:** If the catchment has steep slope, runoff will be more and if catchment has flat terrain or depression runoff will be less. 3. **Soil characteristics of the catchment:** Catchment consisting of rocky soil has more runoff and if it is consist of sandy soil; runoff will be less due to infiltration losses. 4. **Shape and size of catchment:** If catchment area is small and fern shaped, runoff will be less. And if catchment area is large and fan shaped, runoff will be more.	1 M 3 M (1 M Each)



5. **Geological conditions of catchment area:** If catchment area consists of fissures, cracks, undulations, losses will be more and runoff will be less.
6. **Cultivation and vegetation cover in catchment area:** If over catchment area cover of cultivation, vegetation is more, runoff will be less.
7. **Weather conditions:** If temperature in the catchment area is high, runoff will be less due to evaporation losses and vice versa.

b. **Define percolation tank and state the points to be considered for selecting the site for percolation tank.** **4 M**

Ans **Percolation tank** is an artificially constructed surface. Water percolates from the tank and meets the ground water table. Due to this the water level of existing wells increases and then it is pumped for irrigation 1M

They are constructed at suitable site by providing earthen dam and this is indirect system of irrigation.

Points to be considered for selecting the site for percolation tank :

1. To allow the percolation of water, the bed of tank should be pervious.
2. The nalla or stream should have sufficient discharge in monsoon.
3. There should be sufficient number of wells on downstream side of percolation tank.
4. The flanks on both side of nalla or stream should be rising with steep slope.
5. An agricultural land should be available near each well for irrigating the crops.
6. Construction material, labour, machine should be available near the site.

3 M (1 M Each)

c. Differentiate between sprinkler irrigation and drip irrigation on any four points. **4M**

Sr.No	Drip Irrigation	Sprinkler Irrigation
1	Initial investment is more	Initial investment is less.
2	Dripping valves are present in drip irrigation.	Spray guns and nozzles are used in sprinkler irrigation system.
3	Only the root area is witted by drip irrigation.	Sprinkler wets an area of a circle, which covers a number of plants. More area is wetted by this system.
4	Drip irrigation prevents the spreading of diseases.	Sprinkler irrigation dose not prevents the spreading of diseases.
5	Runoff and evaporation is less in this method of irrigation.	Runoff and evaporation is higher in this method of irrigation.
6	The effectiveness and efficiency is higher in drip irrigation.	The effectiveness and efficiency is lesser in sprinkler irrigation.

4M
(1 M Each)

d. Define hydrology and explain hydrological cycle. **4M**

Ans

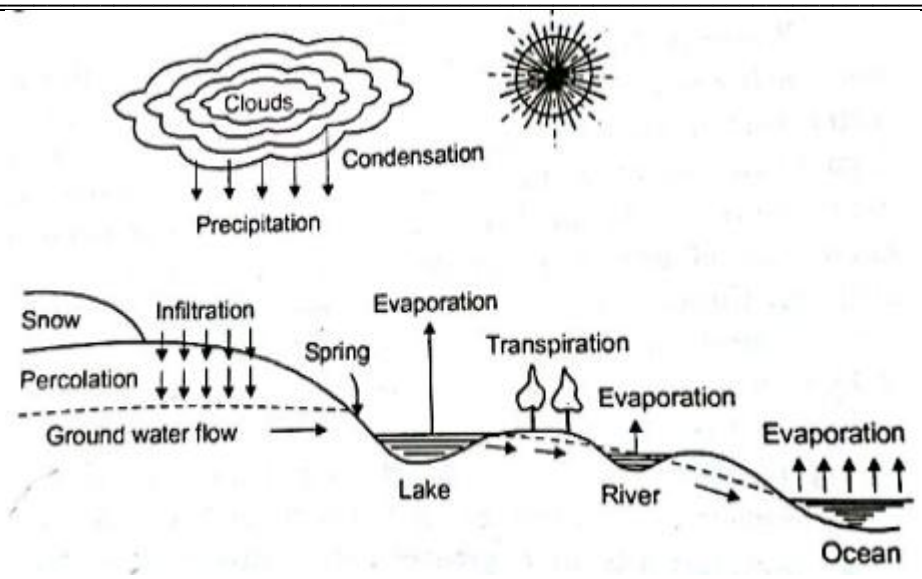
Hydrology is the science which deals with the occurrence, distribution and movement of water on the earth, including that in the atmosphere and below the surface of earth. 1M

Hydrological cycle:

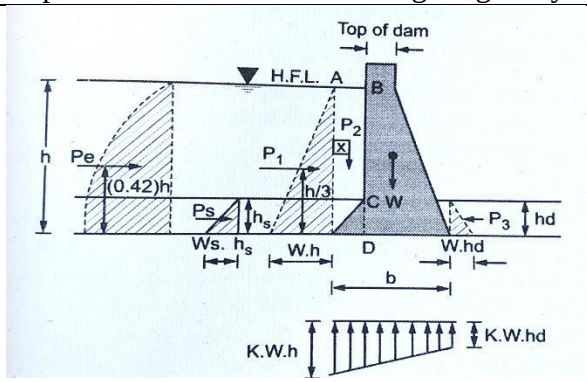
The earth's water circulatory system is known as the hydrologic cycle. Hydrologic cycle is the process of transfer of moisture from the atmosphere to the earth in the form of precipitation, conveyance of the precipitated water by streams and rivers to ocean and lakes etc., and evaporation of water back to the atmosphere. 3M

The hydrologic cycle consist of following processes

1. **Evaporation and Transpiration:-**
   The water from the surface of ocean, river, and lakes and also from the moist soil evaporates. The vapours are carried over the land by air in the form of clouds. Transpiration is the process of water being lost from the leaves of plants from their pores.
2. **Precipitation:-**
   Precipitation may be defined as the fall of moisture from the atmosphere to the earth surface in any form. Precipitation may be in two forms a) Liquid precipitation b) Frozen precipitation.
3. **Run Off:-**
   Runoff is that portion of precipitation that is not evaporated. When moisture falls to the earth's surface as precipitation, a part of it is evaporated from the water surface, soil and vegetation and through transpiration by plants, and the remainder precipitation is available as run off which is ultimately runs to the oceans through surface or subsurface streams.



Q.4		**Attempt any THREE of the following:**	**12**
	a.	**Derive the relationship between Duty, Delta and Base period.**	**04**
	Ans.	Let, D = duty in hectares/cumec. Δ = total depth of water supplied in metres B = base period in days	1M
		1. 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. $=D\times\Delta\times10^4=D\times\Delta\times10^4$ cubic-meters. .... (1)	1M
		2. 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. $=(1)\times(B\times24\times60\times60)m^3=(1)\times(B\times24\times60\times60)m^3$ .... (2)	1 M
		Equating Equations (1) and (2), we get $D\times\Delta\times10^4=B\times24\times60\times60D\times\Delta\times10^4=B\times24\times60\times60$ $\Delta=(B\times24\times60\times60)/(D\times10^4)$ Δ = [8.64B/D] meters.	1M

	b.	Explain the various forces acting on gravity dam with neat sketch.	**04**
	Ans.		Dia 2M

Various forces acting on gravity dam,

1. Water pressure.(P1)
2. Weight of wedge water on u/s (P2)
3. Weight of wedge water on d/s (P3)
4. Weight of dam(W)
5. U/s slit pressure (Ps)
6. Seismic/ earthquake force (Pe)
7. Uplift pressure (U)
8. Wind pressure.
9. Wave pressure.
10. Ice pressure.

2M (1 M Each)

Various forces acting on gravity dam,

1. **Water pressure (P1):**
   It is the major external force acting on dam,
   $P1=(1/2).w.h.h = (wh^2/2)$
   Where,
   w = specific weight of water.
   h = heat of water on u/s.
   Acting at h/3 from base. This is overturning force.
2. **Weight of wedge water on u/s (P2):**
   1. It acts downwards through center of gravity
   2. This is Retaining force. This force P2 is the weight of water per unit length contained in the area ABCD.
   3. It acts through center of gravity of the area.(this force is to be considered when u/s face is partly vertical and partly inclined.
   4. If u/s face is fully vertical only P1 is to be considered.
3. **Weight of wedge water on d/s (P3):**
   1. This is the weight of water on d/s wedge acting at center of gravity this is retaining force.

   $P3=(1/2).w.hd.hd = (w.hd^2/2)$
   Acting at d/3 from base.
   Where,
   hd= depth of water on d/s.

4. Weight of dam (W):

1. This is the main stabilizing force which counters balance all the external forces acting on the dam.
2. So the dam should be constructed with heavy materials of high specific gravity.

W = Area of cross section of dam x Unit weight of dam material

- Acting at center of gravity of dam section downwards, this is the retaining force.

5. U/s silt pressure (Ps):

1. This is the force due to deposition of slit on u/s carried by flowing water. This is the overturning force.
2. **$Ps=(1/2).Ws.hs.hs.\frac{(1-\sin\emptyset)}{(1+\sin\emptyset)}$**

$$= \frac{ws.hs^2}{2} . \frac{(1-\sin\emptyset)}{(1+\sin\emptyset)}$$

$$Ps = \frac{ws.hs^2}{2} . \frac{(1-\sin\emptyset)}{(1+\sin\emptyset)}$$

Acting at hs/3 from base.

Where,

Ws = weight of submerged silt.

$\emptyset$ = Angle of internal friction of the silt.

hs = depth of silt.

6. Seismic / Earthquake force(Pe):

When the selected dam sites come under the seismic zone, the effect of earthquake waves should be taken into account as it is dangerous for the structure.

$Pe = 500.h^2$

Acting at (0.42)h approximately in d/s direction. This is overturning force.

7. Uplift Pressure (U):

- It is the pressure due to the seepage of water through the foundation.
- It acts vertically upwards on foundation of dam and reduce the effective weight.
- To reduce the seepage i.e. uplift pressure galleries are provided on base of dam.

$$U = \frac{(k.w.h + k.w.hd)}{2} . b$$

$$U = k.w.h. \frac{(h+.hd)}{2}$$

Where,

K = permability of foundaion.

K = 0 for hard pervious rock.

K = 0.2 to 0.6for other rock.

8. Wind Pressure :

- The wind acting on all exposed faces of dam exert pressure in wind direction .this pressure depends upon speed of wind.

9. Wave Pressure :

- When very high wind flows over the water surface of the reservoir, waves are formed which exerts pressure on upper part of dam.
  The magnitude of wave depends upon velocity of wind, depth of reservoir and area of water surface. This force is given by,
  P = (1/2).Pw.(5/3). hw
  P = 2000(hw)^2

  Where,
  Pw = 2400 X hw.km/m^2
  Hw = Height of wave
  It acts at (3/8). Hw above F.R.L

10. Ice pressure :

- In extreme cold climate, the top surface of the reservoir freezes into ice.
- Due to variation in temperature, ice expands during day time and exerts pressure on dam.
- This force acts along the length of dam at reservoir level.

c. Differentiate between earthen dam and gravity dam. **4M**

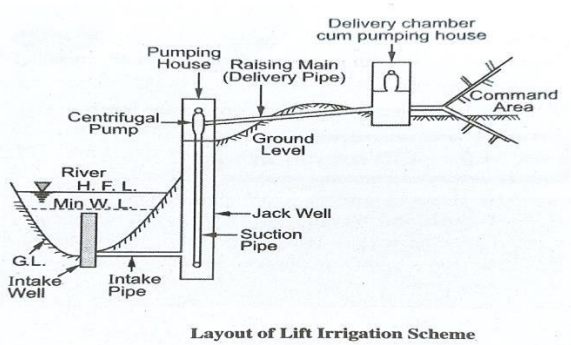
Ans.

Parameters	Earthen Dam	Gravity Dam
Seepage	More seepage	Less seepage
Foundation	Suitable on almost any foundation	Suitable only when foundation is of solid rock having no fissures, cracks, cavities, etc.
Construction	Construction materials are stone, earth containing silt, clay, and sand Construction	materials are stone, brick, concrete, etc.
Maintenance	More costly	Less costly
Labour	Require less skilled labour	Require more skilled labour
Stability	More susceptible to failure	Less susceptible to failure

4 M
(1 M Each)

d. Draw a layout of lift irrigation scheme. Explain its functions with component parts. **4M**

Ans. Layout of lift irrigation scheme:



Layout of Lift Irrigation Scheme

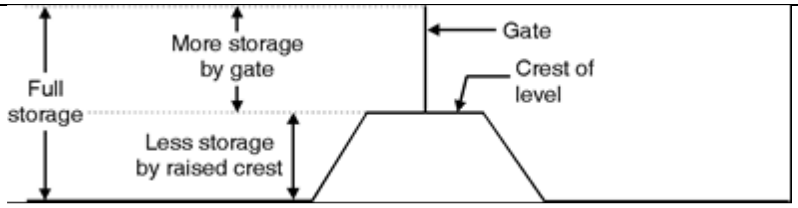
Dia
2 M

2M
(1 M Each)

Component parts with their functions:

1. Intake Well :
   - It is a well-constructed in the bed of the river at a suitable site to collect the water from the source.
   - It should have its upper portion constructed below the minimum water level expected at any time and bottom portion embedded well below the bed of the river.
2. Intake Pipe:
   - The purpose of the intake pipe is to convey the collected water from intake well to jack well which is constructed to lift the water to the raising main.
3. Jack well :
   - The water from intake well is carried out to jack well through intake pipe, proper care should be taken, so that the jack well does not get settle and remains stable.
   - It should not be submerged by the water in the river during the periods of high floods.
4. Centrifugal Pump and pumping house:
   - A centrifugal pump with suction pipe is provided with non-return foot valve which is installed in jack well.
   - The level of foot valve should be always below the minimum water level in the river.
5. Raising main (Delivery pipe):
   - It is a delivery pipe which transmits the water from jack well to the delivery chamber cum pumping house for the next stage.
   - The length of the raising main should be small and the slope of pipe should not be too steep, to avoid back flow, water hammer in pipe etc.
   - The alignment of the raising main should avoid the excessive cutting or lowering of the pipe.
6. Delivery chamber cum pumping house:
   - The water from raising main is delivered to this chamber.
   - The elevation of this chamber should be such that the water can easily flows into the distribution system by gravity flow.
   - Another centrifugal pump may be installed in the delivery chamber if the water is to be lifted to the next stage of the lift irrigation scheme.
7. Distribution system:
   - The water may be conveyed to the command area either by gravity canals or by suitable underground distribution system depending upon the site conditions.

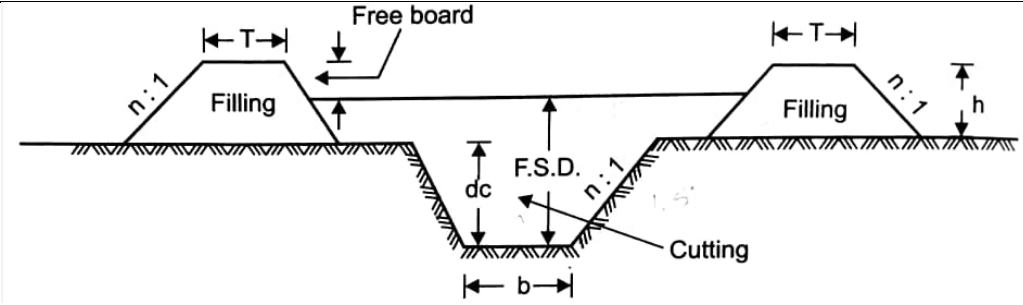
Q-5		Attempt any TWO of the following:	12 M
	a.	**Calculate the base width of the elementary section of gravity dam from the following data: Unit weight of concrete = 2480 Kg/m³** **H.F.L. at R.L. = 373.00 m Coefficient of permeability (K) = 0.3** **Coefficient of static friction (μ) = 0.70**	6M
	Ans.	Given, K= 0.3, μ = 0.7, H =H.F.L. at R.L. = 373 m Unit weight of concrete = 2480 Kg/m³ G = Specific gravity = Unit weight of concrete/1000 Kg/ m³ (unit weight of water) G = 2.48 Conditions to be fulfilled are i) No Tension: b = H/√(G-K) =373/√(2.48-0.3) = 373/√2.18 = 373/1.4765 b = 252.62 m. ii) No Sliding: b= H/(G-K) μ =373/(2.48 – 0.3) 0.7 =373/1.526 b= 244.43 m. The highest among the two base width value is to be selected i.e. b = 252.62 m	1M 2M 2M 1M

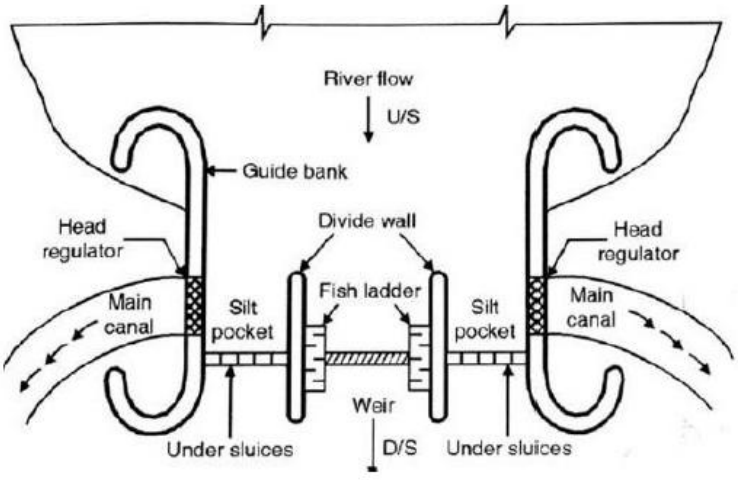
	b)	**Draw a neat sketch of Barrage with its components. Enlist any two advantages and disadvantages of it.**	**6M**
	Ans	 **Advantages of Barrage:-** 1. Area under submergence of water is less. 2. Cost of rehabilitation is less. 3. It is economical as cost of protective and energy dissipation work is less. 4. All the stored water can be utilised for irrigation & other purposes. 5. Collected silt in the barrage can be regularly removed hence used with full capacity throughout its life. **Disadvantages of barrage:-** 1. Storage capacity is less as compared to dams. 2. Initially needs high cost for construction. 3. Maintenance cost is more.	2 M for sketch with labeling 2 M (1 M Each) 2 M (1 M Each)
	c.	**Fix the control levels DSL, FRL, HFL and TBL from following data:** **i) Effective storage required 3000 Ha.m.** **ii) Carry over allowances and tank losses - 25%** **iii) Dead storage- 10% of gross storage.** **Assume Flood lift as 1.5m and free board as 2.5 m.**	
	Ans	Effective live storage = 3000 Ha.m Dead storage = 10% of Gross storage $= \frac{10}{100} = 0.1$ of Gross storage Carry over allowances and tank losses = 25% $= \frac{25}{100} \times 3000 = 750$ Ha.m Total live storage = Effective live storage + Carry over allowances and tank losses = 3000 + 750 =3750 Ha.m = 37.50 Mm^3	**1M**

Contour RL (m)	580	582	584	610	612	614
Storage (Mm^3)	3.0	4.5	6.0	30	40	50

		Dead storage = 0.1 of Gross storage Gross storage = Live storage + Dead storage Gross storage = 37.50 + 0.1(Gross storage) 0.9 Gross storage = 37.50 Gross storage = $\frac{37.50}{0.9}$ = 41.66 Mm^3 Dead storage = 0.1 x 41.66 =4.16 Mm^3 By using interpolation method DSL =580 + $\frac{(4.16-3) \times (582-580)}{(4.5-3.0)}$ **DSL = 581.55 m** By using interpolation method FRL= 612 + $\frac{(41.66-40) \times (614-612)}{(50-40)}$ **FRL = 612.33 m** HFL= FRL + Flood lift = 612.33 + 1.5 **HFL = 613.83 m** TBL= HFL + free board = 613.83 + 2.5 **TBL = 616.33 m**	1M 1M 1M 1M 1M
Q 6		**Attempt any TWO of the following:**	**12 M**
	a)	**Find the designed discharge of a canal having following details:-** **1) Transit losses = 18%** **ii) Time factor = 0.7** **iii) Capacity Factor = 0.8**	**6M**

Sr. No.	Name of the Crop	Area under irrigation (Ha)	Duty at field in Ha/cumec
1	Sugarcane	350	700
2	Rice (Kharif)	150	600
3	Bajari (Kharif)	600	1500
4	Wheat (Rabbi)	1200	1800
5	Vegetable (H.W.)	400	800

	Ans	Transit losses = 18% Time factor = 0.7, Capacity Factor = 0.8 For Sugar cane Q = Area / Duty = 350 / 700 = 0.5 cumec For Rice (Kharif) Q = Area / Duty = 150 / 600 = 0.25 cumec For Bajari (Kharif) Q = Area / Duty = 600 / 1500 = 0.4 cumec For Wheat (Rabbi) Q = Area / Duty = 1200 / 1800 = 0.67 cumec For Vegetable (H.W.) Q = Area / Duty = 400 / 800 = 0.5 cumec Discharge required for Kharif season = 0.5 + 0.25 + 0.4 = 1.15 cumec Discharge required for Rabbi season = 0.5 + 0.67= 1.17 cumec Discharge required for HW = 0.5 + 0.5= 1.0 cumec Design Discharge = $\frac{Q_{max}}{\text{Time Factor} \times \text{Capacity Factor} \times \text{Transit Losses}}$ Design Discharge = 1.17/ [0.7 x 0.8 x {(100-18)/ 100}] = 1.17/0.459 Design Discharge = 2.55 cumec	1/2M 1/2M 1/2M 1/2M 1/2M 1/2M 1/2M 1M 1M
	b	**Calculate the balancing depth for a canal section having the following details:** **Bed width (b) =4m. F.S.D. = 1.5 m,** **Top width of bank - 2.5 m.** **Side slopes 1.5:1 in cutting** **Side slopes 2:1 in banking** **Free board 0.5 m**	**6M**
	Ans	 Given, b_c = 4m , FSD = 1.5m, Zc = 1.5:1, Zf = 2:1, FB = 0.5m Let 'd_c' be the balancing depth, h = height of bank above GL	

		$= (1.5 + 0.5 – d_c)$ $h = (2 – d_c)$ $\therefore$ Area of cutting $= (b_c + Zd)\, d$ $= (4 + 1.5x\, d_c) \times d_c$ $= 4dc + 1.5\, d_c^2$ Area of filling = 2 (Area of banking) $= 2\,(2.5+ 2\,h)h$ $= 2\,(2.5\,h + 2h^2)$ $= 5h + 4h^2$ Put $h = 2 – d_c$ $= 5(2 - d_c) + 4\,(2 – d_c)^2$ $= 10 – 5d_c + 4\,(4 - 4\,d_c + d_c^2)$ $= 10 - 5d_c + 16 – 16d_c + 4d_c^2$ Area of filling $= 26 – 21\,dc + 4d_c^2$ Area of cutting = Area of filling $4\,d_c + 1.5\,d_c^2 = 26 – 21d_c + 4\,d_c^2$ $0 = d_c^2 – 10\,d_c + 10.4$ $d_c = + 10 \pm \sqrt{(10^2 – 4 \times 1 \times 10.4)/2x1}$ $d_c = 1.18$ m	1M 2M 2M 1M
	c.	**Draw a neat layout of Diversion Head work and write functions of following components of it:** **i) Head Regulator** **ii) Divide Wall** **iii) Fish ladder** **iv) Scouring sluices**	**6M**
	Ans	 **Fig. layout of Diversion Head work** **i) Head Regulator:** 1. To regulate the supply of water entering in canal. 2.To controls the entry of silt into canal. 3. To prevents the river flood entering the canal. **ii) Divide Wall:** 1. To separate flow from scouring weir.	2 M for sketch with labeling 1M (any one)

		2. To separate the stilling pocket from scoring sluices. 3. To prevent formation of cross currents to avoid damaging effects. 4. To cut off the main portion of the river & provide a comparatively quite, pocket in front of the canal head regulator resulting in deposition of silt in the pocket & enter clear water in the canal. **iii) Fish ladder:** 1. To provide free movement of fishes. 2. To help the survival of the fishes. **iv) Scouring Sluice:** 1. To scour deposited silt and soil. 2. To provide greater waterway for floods. 3. To control the silt entry into canal.	1M (any one) 1M (any one) 1M (any one)