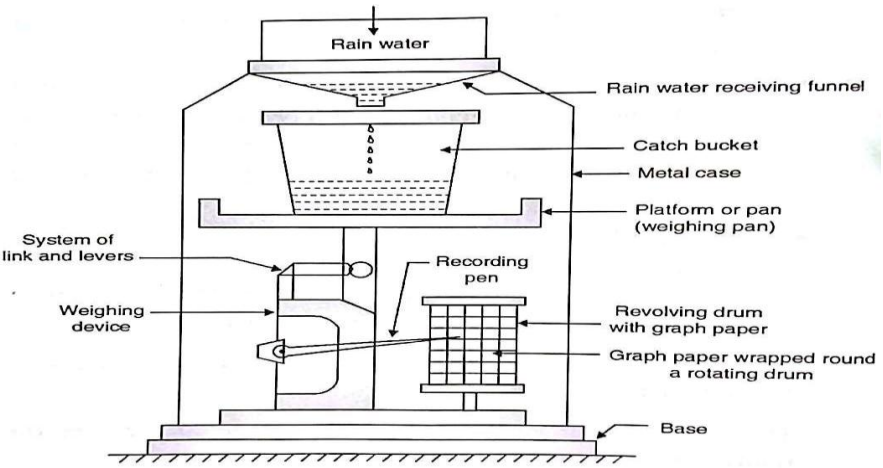
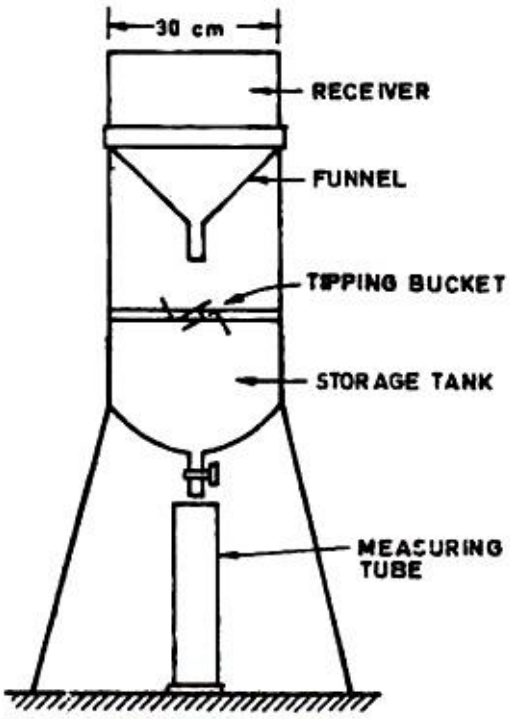
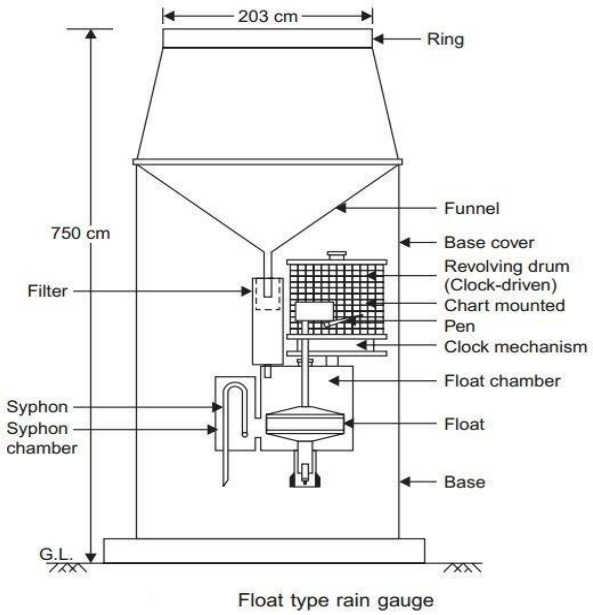
Subject: Irrigation Engineering **Subject Code: 17502**

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	**a)**	**Attempt any THREE of the following:**		**12M**
	(i)	**State any four advantages and four ill effects of irrigation.**		
	Ans.	**Advantages of irrigation:**		
		1. Increase in yield of crops		
		2. Protection from famine	½	
		3. Improvement of cash crops / Elimination of mixed crop	**mark**	
		4. Rise in social standards	**each**	
		5. Revenue generation	**(any**	
		6. Navigation	**four)**	
		7. Hydroelectric power generation		
		8. Water supply		
		9. Increase in facilities of communication		**4M**
		10. Development of fishery.		
		Ill effects of irrigation:	½	
		1. Rising of water table /water logging	**mark**	
		2. Formation of marshy land	**each**	
		3. Dampness in weather	**(any**	
		4. Loss of valuable land	**four)**	
		5. Tendency towards over irrigation.		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**(ii) Ans.**	**Explain with neat sketch automatic rain gauge. (any one)** **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.	**2M** **2M**	**4M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**(ii)**	 **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)**		

Q.1 (iii) **From following data find out the average annual rainfall by Isohyetal method.**

Isohytes (mm)	**9-10**	**10-11**	**11-12**	**12-13**	**13-14**	**14-15**
Area between Isohytes (km^2)	**22**	**80**	**105**	**90**	**70**	**16**

Ans.

Isohytes (mm)	Area between Isohytes (km^2)	Average rainfall ½ (P1+P2)	Product of columns 2 and 3 A x ½ (P1+P2)
1	2	3	4
9-10	22	9.5	209
10-11	80	10.5	840
11-12	105	11.5	1208
12-13	90	12.5	1125
13-14	70	13.5	945
14-15	16	14.5	232
Total	383	--	4559

$P_{av} = [\Sigma A (P1+P2)/2]/ \Sigma A = 4559/ 383 = 11.90$ mm

4M **4M**

(iv) Ans. **State meaning of 1) Crop period 2) Base period 3) Duty 4) Delta**

1) **Crop period :** It is the period in number of days that crop takes from the instant of its sowing to that of its harvesting.
2) **Base period :** It is the period in days from first watering at the time of sowing to the last watering before harvesting.
3) **Duty** : Duty is the area in hectares (ha) irrigated by one cubic per meter per second of water flowing continuously for the base period for a particular crop
4) **Delta:** Delta is total depth of water required by a crop during the entire period of the crop from first to last watering for complete maturity of the crop.

1 Mark each **4M**

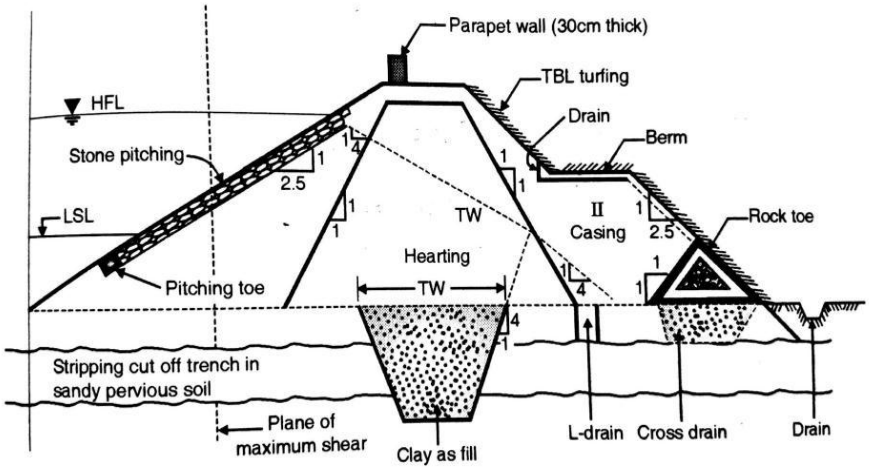
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**b)**	**Attempt any ONE of the following:**		**6M**
	(i)	**A tank has a catchment area of 120 km^2 out of which 20 km^2 is independent. The average annual rainfall of the catchment is 80 cm. The runoff of average bad year is 20 % of annual average bad year. The runoff from the intercepted catchment available for this tank is 20% of actual runoff. Calculate the assured yield.**		
	Ans.	Total catchment area = 120 km^2		
		Intercepted catchment area = 100 km^2		
		Rainfall annual = 80 cm		
		Rainfall in bad year = (80 x 80) / 100 = 64 cm	**1M**	
		Runoff from independent and intercepted catchment area is 20% of rainfall of average bad year.		**6M**
		R (independent) = (20 x 64) / 100 = 12.8 cm	**1M**	
		R (intercepted) =(20 x 12.8) / 100 = 2.56 cm	**1M**	
		Yield from independent catchment area = 20 x 12.8 = 256 Ha-m	**1M**	
		Yield from intercepted catchment area = 100 x 2.56 = 256 Ha-m	**1M**	
		Total = 256+ 256 = 512 Ha-m	**1M**	
	(ii)	**Fix control level of medium size reservoir from the given data.**		
		Effective storage required for crops = 300 ha-m		
		Tank losses = 20 % of effective storage		
		Carry over allowances = 10 % of effective storage		
		Dead storage = 10% gross storage		

Contour (RL)	**250**	**253**	**256**	**278**	**281**	**284**
Storage (Mm^3)	**3.20**	**4.10**	**5.25**	**42.65**	**47.30**	**55.12**

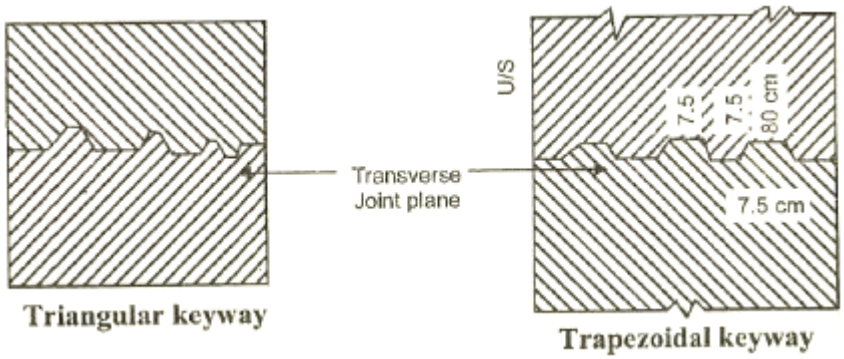
			Flood lift = 3m, Free Board = 3m					
	Ans.	Effective storage required for crops = 300 ha-m = 3Mm^3						
		Gross storage = Dead storage + Live storage						
		Live storage = Effective crop water requirement + Tank losses + Carry over allowance						
		Effective storage required for crops = 300 ha-m =(3 Mm^3)						
		Live storage = 3 + (20/100) (3) + (10/100) (3)= 3+0.6+0.3= 3.9 Mm^3					**1M**	
		Live storage = 3.900 Mm^3						
		From Equation (1),						
		Gross storage = $\frac{10}{100}$ of gross storage + 3.9						
		0.9 Gross storage = 3.9					**1M**	
		$\therefore$ Gross storage = 4.33 Mm^3						
		From capacity table, by interpolating R.L. corresponding to the capacity 4.33 Mm^3 will be,						
		= $253 + \frac{(256-253)}{(5.25-4.10)} \times (4.33-4.1)$					**1 M**	
		= 253.6 M						

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**b) ii)**	∴ F.R.L.= 253.6 M Assuming flood lift and free board = 3 m ∴ HFL = FRL + Flood lift = 253.6 + 3 HFL = 256.6 m TBL = HFL + Free board = 256.6 + 3 = 259.6 m **Dead storage = $\frac{10}{100}$ of gross storage** **= $\frac{10}{100} \times 4.33 = 0.433\ Mm^3$** **R.L. corresponding to the capacity of 0.433 Mm^3** **=** **∴ D.S.L. =** **NOTE :-The values of Storage (Mm^3) given in table are not appropriate for finding the value of DSL. If suitable value assumed by the students and tried to attempt the question, appropriate marks should be given.**	**1M** **1M** **1M**	**6M**

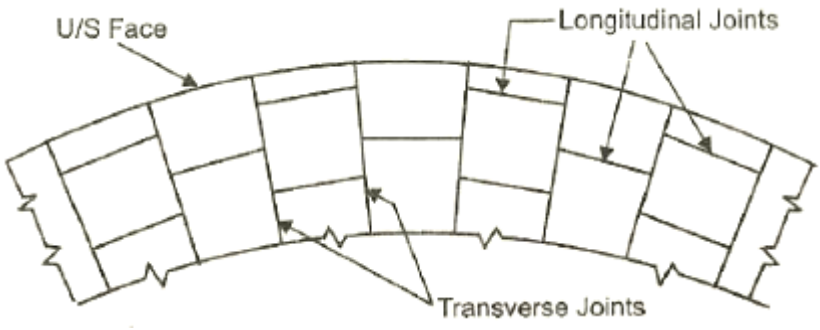
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2		**Attempt any <u>FOUR</u> of the following:**		**16M**
	a)	**State four factors affecting rate of silting of reservoir.**		
	Ans.	Factor affecting silting in a reservoir are as follows: i) **Catchment area**: If catchment area is more, silting will be more. If catchment area is less, silting will be less. ii) **Shape of catchment**: If catchment area is fan shaped, silting will be more. If catchment area is fern shaped, silting will be less. iii) **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. iv) **Climatic condition**: Dry and rainy climate helps in production of more silt material. v) **Nature of surface soil**: If soil is weathered or loose it can be easily flow with runoff and deposited in reservoir.	**1 Mark each (any four)**	**4M**
	b)	**List the data collected engineering survey for an irrigation project.**		
	Ans.	**<u>Data to be collected for engineering surveys :</u>** 1. Contour maps 2. Contour Area curves 3. Storage elevation curves 4. Hydrological data i.e. rainfall, runoff, MFD etc. 5. Materials for construction 6. Population survey for submergence area 7. Land acquisition details 8. Existing roads, railway lines and historical monument	**½ Mark each**	**4M**
	c)	**Write the functions of the following components of earthen dam.** **i) Berms. ii) Cross Drain. iii) COT. iv) Turfing.**		
	Ans.	**i) <u>Berms:</u>** a) It provides road way for vehicle. b) It reduces velocity of rainwater falling on slope. c) It collects rain water and disposes it off safely. d) It provides minimum cover of 2 m above seepage line. **ii) <u>Cross drain:</u>** Main function of cross drain is to collect seepage from L drain and downstream casing and dispose it to the toe drain **iii) <u>Cutoff trench (COT)</u>** : The function of cutoff trench is to prevent or reduce seepage flow through the pervious foundation. And also prevents overturning of dam **iv) <u>Turfing:</u>** It is special type of grass planted over the downstream face of the dam, which protect downstream slope from eroding action of rain water.	**1 mark for each Function**	**4M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**d) Ans.**	**Draw a neat labeled sketch of Earthen dam.**  	**2 marks for Sketch and 2 marks for labeling**	**4M**
	e) Ans.	**Explain hydraulic failures and seepage failure of earthen dam.** **1. <u>Hydraulic failures:</u>** About 40% of earthen dam failures due to this reason only. It includes Overtopping of dam surface, failure of u/s slope due to wave erosion, toe erosion, gullying etc. These failures can be avoided by taking following remedial measures. Design capacity of spillway accurately. Provide sufficient free board. Stone pitching and wave breakers on upstream face. **2. <u>Seepage failures:</u>** More than 33% of earthen dam failures due to seepage. Seepage always occurs in earthen dam. It does not harm its stability if it is within design limit. It includes Piping, Sloughing. These failures can be avoided by taking following remedial measures. 1) Proper compaction & bonding between layers. 2) Careful investigations of foundation soil 3) Proper design.	**2M** **2M**	**4M**
	f) Ans.	**State the eight factors affecting selection of site for gravity dam.** The selection criteria for site of a dam is- 1. Good foundation should be available. 2. It should be located in a narrow valley 3. It should have sufficient space for spillway 4. It should have impervious bed and site so as to reduce erosion 5. It should fulfill the purpose i.e. irrigation, drinking etc. 6. Materials should be easily available near by site 7. It should have less submergence area i.e. not more than 10% 8. The site should be such that the length of dam should be minimum as it directly affect cost 9. It should be easily accessible throughout the year.	**½ mark for each (any eight)**	**4M**

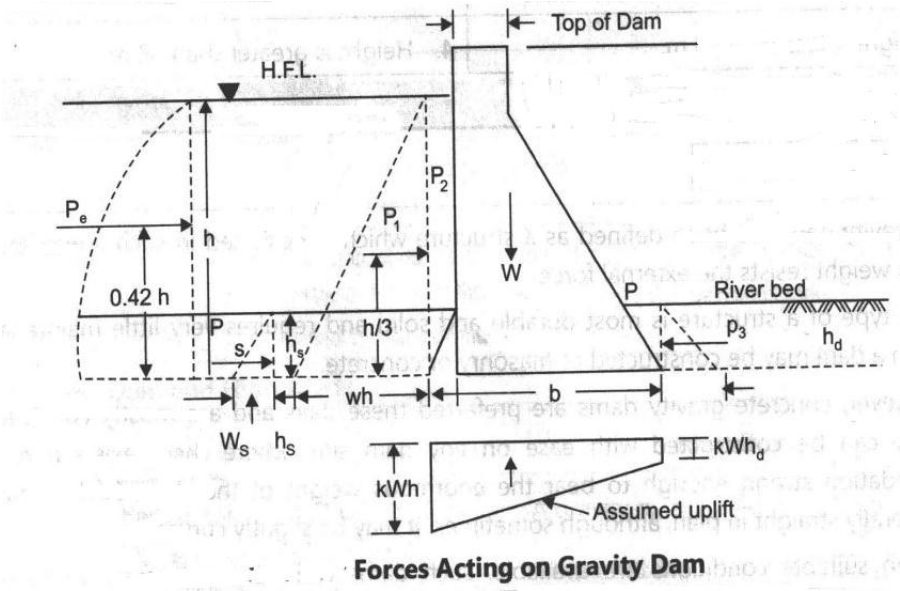
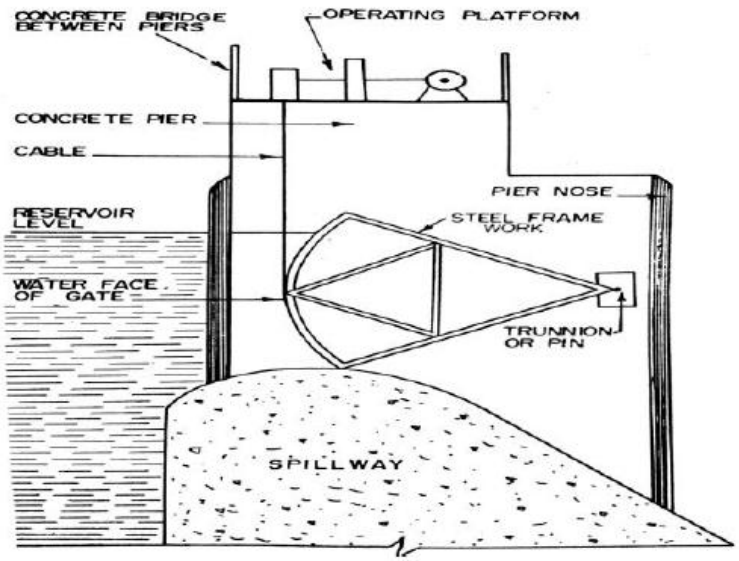
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3		**Attempt any FOUR of the following:**		**16 M**
	a)	**Describe with sketch types of joints used in gravity dam. (any two)**		
	Ans.	There are two types of joints – 1) Construction joint 2) Contraction joint (1) Construction Joint: In solid gravity dams, the height between horizontal joints is usually limited to 1.5 m. This height between two successive construction joints or horizontal joints is known as lift. The surface should be properly treated to make the horizontal joint water tight.	**1M**	
		(2) Contraction Joint : They are provided to avoid cracks formed due to shrinkage of concrete due to temperature changes. These joints are of two types – a) Transverse Joint b) Longitudinal Joint (2.a) Transverse Joint: These are provided normal to axis of dam. They prevent the transverse cracks due to contraction of concrete. The joint is filled with asphaltic filler. (2.b) Longitudinal Joints : These are provided parallel to the axis of dam to prevent longitudinal cracks. Water stops are provided to prevent leakage of water. The spacing of these joints is limited to 15m. Key ways are invariably provided in vertical longitudinal joints. Function of keyway is to permit transfer of shearing stress from one block to other.	**1M** **2M**	**4M**

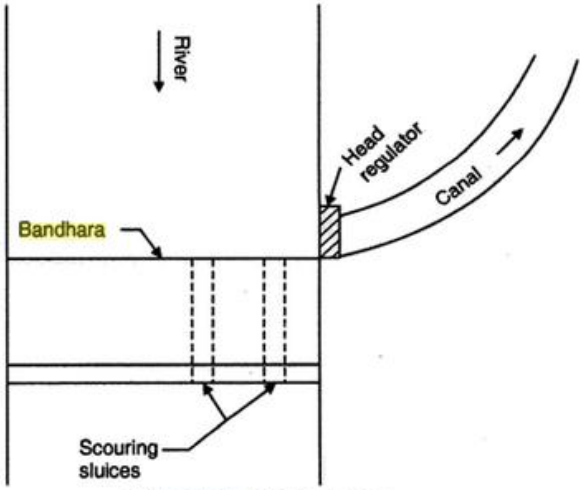


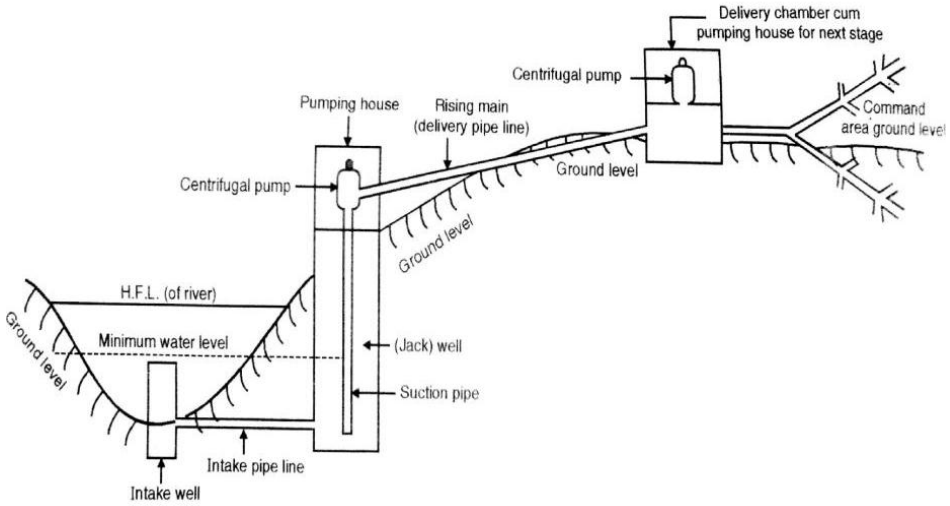
Transverse Joints



Longitudinal Joints

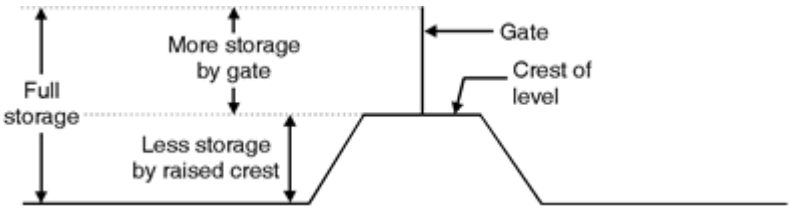
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**b)**	**Enlist the forces acting on gravity dam. Show them with neat sketch.**		
	Ans.	Following are the forces acting on gravity dam: 1. Water pressure on upstream side 2. Water pressure on downstream side 3. Weight of the dam 4. Upstream silt pressure 5. Seismic forces 6. Uplift forces 7. Ice pressure 8. Wind pressure	**2M**	**4M**
		 **Forces Acting on Gravity Dam**	**2M**	
	c)	**Draw a neat labelled sketch of radial gate. State its suitability.**		
	Ans.	**Suitability of radial gate :** It is used for big spans varying from 4 m to 15 m height 3 m to 10 m **Sketch of radial gate:**	**1M**	
			**2 Mark for diagram and 1 mark for labeling**	**4M**

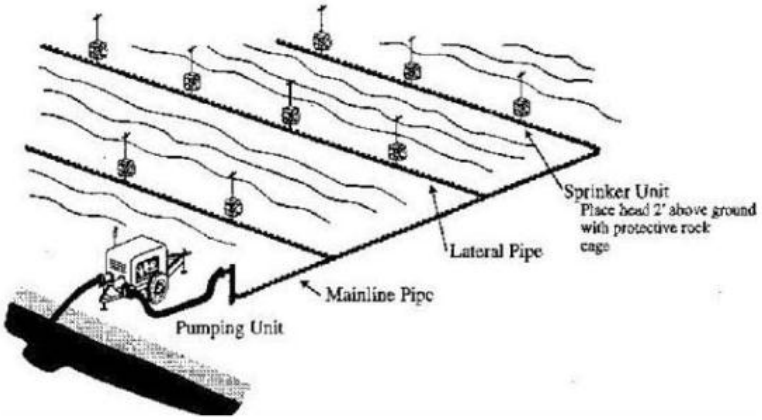
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**d) Ans.**	**State four points for selection of site for percolation tank.** **Selection of site for percolation tank:** The following are the requirements of site for percolation tank, (1) The bed of tank should be pervious. So that water will percolate and join ground water. (2) There should be sufficient number of wells in the command area. If wells are not there then it will have to dig. (3) The site at which bunds are constructed should have sufficient discharge. (4) The side of stream should be steep. If the side are not steep it should be made by rising both sides. (5) For construction the material and labours should available near by the site.	**1 mark each (any four)**	**4M**
	e) Ans.	**Draw layout of bandhara and state its component parts.**  (a) Bandhara irrigation layout **Component parts of Bandhara-** 1. Bandhara 2. Screen wall and outlet 3. Scouring sluices 4. Canal on lining wall(off taking canal)	**1 Marks for diagram and 1 mark for labeling** **2M**	**4M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**a)**	**Attempt any THREE of the following:**		**12M**
	i)	**Draw layout of lift irrigation scheme, list the components of scheme.**		
	Ans.		**2M**	
		Components of lift irrigation scheme:- 1) Intake channel 2) Inlet chamber 3) Jack well 4) Inlet pipe 5) pump House 6) Rising Main 7) Storage Tank 8) Water Distribution System 9)Pumping Machinery	**2M**	**4M**
	ii)	**Compare between drip irrigation and sprinkler irrigation on any four points.**		
	Ans.		**1 mark each (any Four)**	**4M**

Sr. No	Drip irrigation	Sprinkler irrigation
1	Initial investment is more.	Initial investment is less.
2	Dripping valves are present in drip system.	Spray guns and nozzles are used in sprinkler system.
3	Only root area is irrigated in 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 system does not prevent the spreading of diseases.
5	Run off and evaporation is less in Drip method.	Run off and evaporation is higher in sprinkler method.
6	The effectiveness and efficiency is higher in drip irrigation.	The effectiveness and efficiency is lesser in sprinkler irrigation.

	iii)	**What is diversion head works? State its component with functions.**		
	Ans.	**Diversion head works:** The works which are constructed at the head of the canal , in order to divert the river water towards the canal , so as to ensure regulated continuous supply of silt free water with certain minimum head into that canal is called as diversion head works.	**1M**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**iii)**	**Component with functions –** **Weir-** **1.** To raise water level **2.** To direct water into the canal **Divide wall:** 1.To separate flow from the scouring weir which is at lower level than proper weir 2. To separate the silting packet from scouring sluices 3. To prevent formation of cross currents to avoid domain effects 4. To cut off the main portion of the river and provide a comparatively quite packet in front of the canal head regulator resulting in deposition of silt in the pocket and enter clear water in canal. **Fish ladder:** 1. To provide free movement of fishes 2. To help the survival of the fishes **Head regulator:** 1. It regulate the supply of water entering in canal. 2.It controls the entry of silt into canal 3. it prevents the river flood entering the canal **Scouring Sluice:** 1. Deposited silt and soil are scoured through the scouring sluice. **Silt Ejectors**: 1. To extract the silt from canal water	**1 Mark each (any three)**	**4M**
	iv) **Ans.**	**Draw a labelled sketch of barrage and state two advantages of it.**  **Advantages of barrage:** 1. There is less silting and better control over the level of water. 2. Low cost of flood banks. 3. Less cost of protective and energy dissipation work. 4. These are more safe than weir as afflux is less. 5. It is economical as cost of protective and energy dissipation work is less.	**2 M** **1 Mark each (Any two)**	**4M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**b) i)**	**Attempt any ONE of the following:** **State the need of sprinkler irrigation. Draw layout of sprinkler irrigation scheme (Show various components of sprinkler irrigation scheme in layout).**		**6M**
	Ans:	**Need of sprinkler irrigation:** 1. Where water requirement of crop is less. 2. Where slopes are excessive. 3. Where soil is erosive. 4. Where soil is excessively permeable. 5. Where depth of soil is shallow.	**1 Mark Each (Any Two)**	
		 **Lay out of sprinkler**	**3 Marks for diagram and 1 mark for labeling**	**6M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**b) ii)**	**A canal section has following parameters.** **1) Bottom width of canal = 10 m** **2) FSD = 1.5 m** **3) Bank width = 2 m** **4) Side slope in cutting = 1:1** **5) Side slope of filling = 1.5:1** **6) FB = 0.5 m** **Calculate the balancing depth of canal.**		
	Ans:	Let, d_c be the balancing depth. h be the height of bank above GL = $(1.5+ 0.5 - d_c) = (2 - d_c)$ Area of Cutting = $(b + nd) d$ $= (10 + 1x\ d_c)\ d_c$ $= (10+ d_c)\ d_c$	**2M**	
		Area of filling = 2[Area of one bank] $= 2[(2+ 1.5\ h)\ h]$ $= 2[\{2+ 1.5(2 - d_c)\}\ (2 - d_c)]$ $= 2[\{2+ 3- 1.5\ d_c\}(2 - d_c)]$ $= 2[\{5- 1.5\ d_c\}(2 - d_c)]$ $= 2[10-5d_c-3\ d_c + 1.5\ d_c^2]$ $= 2[10-8\ d_c\ +1.5\ d_c^2]$ $= 20-16\ d_c\ + 3\ d_c^2$	**2M**	
		Now ,For balancing depth, Area of cutting = Area of filling Area of cutting = 2 x Area of each bank $(10 + d_c)\ d_c = 20-16\ d_c + 3\ d_c^2$ $10\ d_c + d_c^2 = 20-16\ d_c + 3\ d_c^2$ $0 = 20-26\ d_c + 2\ d_c^2$ $0 = 10-13\ d_c +\ d_c^2$ $d_c = \{ 13\pm \sqrt{(13^2 -4 \times 10)}\}/ 2$ $d_c = 0.82m$	**2M**	**6M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**a)**	**Attempt any TWO of the following:**		**16M**
		The main canal irrigates the following crops calculate the duty of each crop at the head of main canal.		

Sr.No.	Name of Crop	Delta	Transit Losses
1	Jowar (Kh)	45cm	20%
2	Wheat (Rabi)	30cm	40%
3	Sugarcane	180cm	40%
4	Vegetable(H.W)	50cm	40%
5	Ground Nut (H.W)	30cm	40%

Assume suitable data if required.

Ans.

1) Jowar (Kh)

Delta (Δ) =45cm =0.45m

Base Period (B) = 120 days

Duty (D) = $\frac{8.64 \times B}{\Delta} = \frac{8.64 \times 120}{0.45}$ = 2304 ha/Cumec

Considering Transit losses Duty (D)= $\frac{2304 \times 80}{100}$ = **1843.2 ha/Cumec** — **1½ M**

2) Wheat (Rabi)

Delta (Δ) =30cm =0.30m

Base Period (B) = 120 days

Duty (D) = $\frac{8.64 \times B}{\Delta} = \frac{8.64 \times 120}{0.30}$ = 3456 ha/Cumec — **1½M**

Considering Transit losses Duty(D) = $\frac{3456 \times 60}{100}$ = **2073.6 ha/Cumec**

3) Sugarcane (Annual)

Delta (Δ) =180cm =1.80

Base Period (B) = 360 days

Duty (D) = $\frac{8.64 \times B}{\Delta} = \frac{8.64 \times 360}{1.8}$ = 1728 ha/Cumec — **1½M**

Considering Transit losses Duty(D) = $\frac{1728 \times 60}{100}$ = **1036.8 ha/Cumec**

4) Vegetable (H.W)

Delta (Δ) =50cm =0.5m

Base Period (B) = 120 days

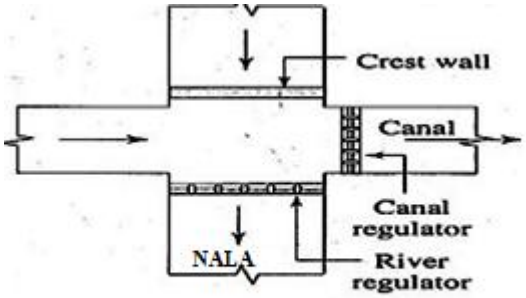
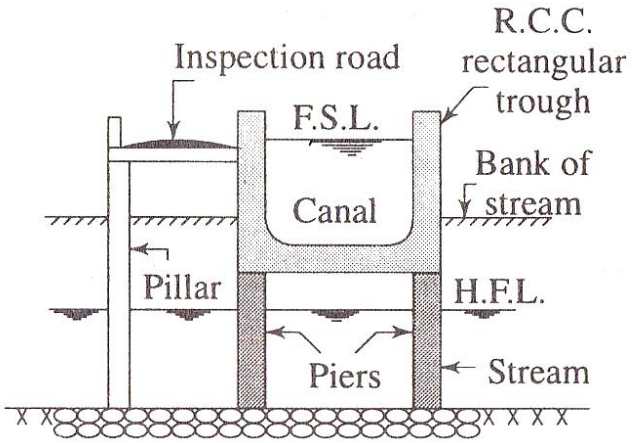
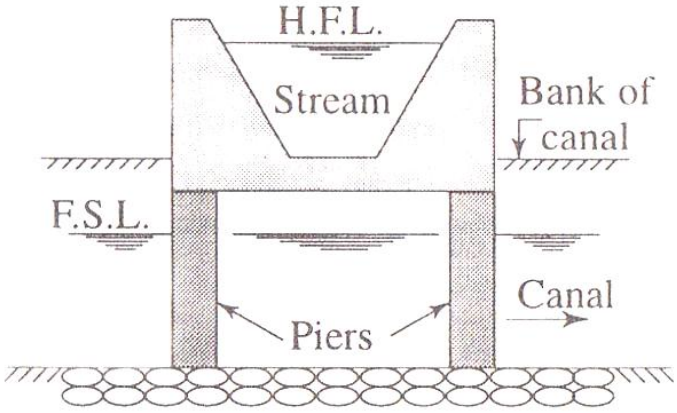
Duty (D) = $\frac{8.64 \times B}{\Delta} = \frac{8.64 \times 120}{0.5}$ = 2073.6 ha/Cumec — **1½M**

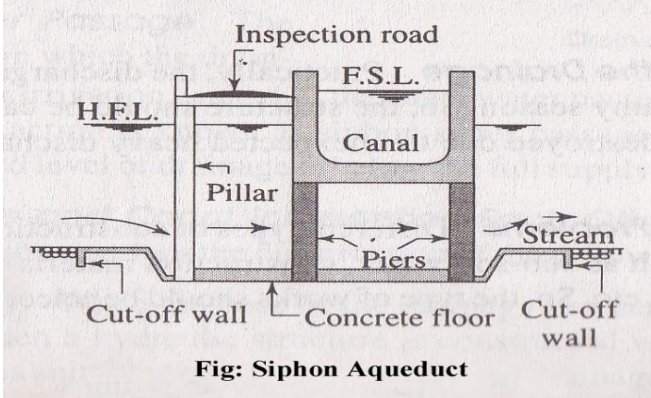
Considering Transit losses Duty(D) = $\frac{2073.6 \times 60}{100}$ = **1244.16 ha/Cumec**

8

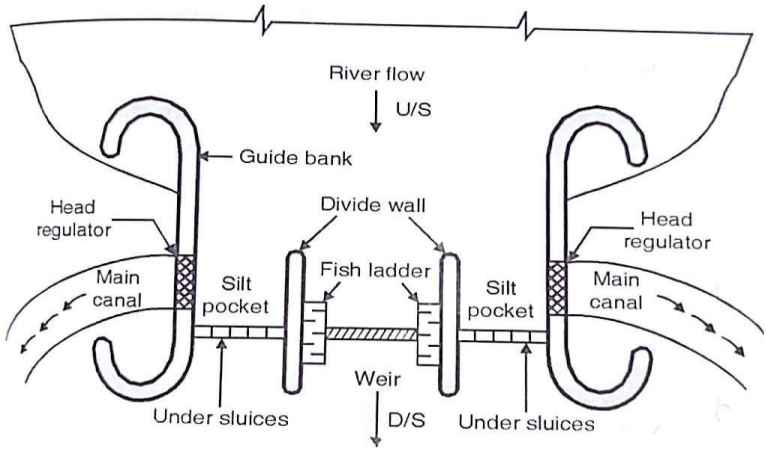
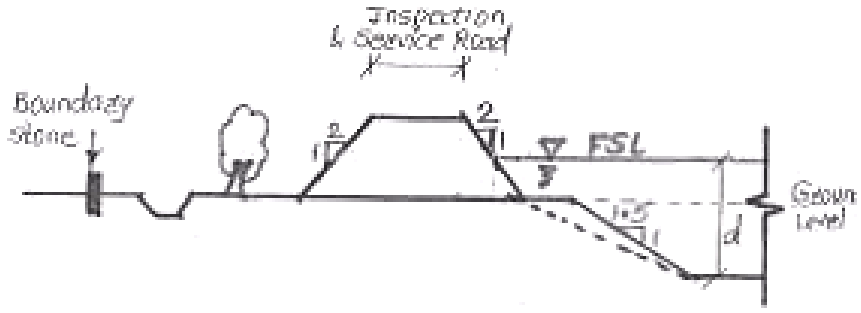
<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q.5</td><td>a)</td><td>5) Ground Nut (H.W)
Delta (Δ) =30cm =0.3m
Base Period (B) = 120 days
Duty (D) = $\frac{8.64 \times B}{\Delta} = \frac{8.64 \times 120}{0.3}$ = 3456 ha/Cumec
Considering Transit losses Duty(D) = $\frac{3456 \times 60}{100}$ = 2073.6 ha/Cumec
(Note: The base period of kharif is 120 or123 days, base period of rabbi is 120 or122 days, base period of annual is 360 or 365 days. If the students assumed above mentioned values and try to attempt the question , give appropriate marks.)</td><td>2M</td><td rowspan="2">8M</td></tr>
<tr><td></td><td>b)

Ans.</td><td>Compare between Earthen dam and Gravity dam w.r.t Foundation, Seepage, Construction Material, Length of dam, Construction method, cost, manpower required, Maintenance.
<table>
<tr><th>Criteria</th><th>Earthen dam</th><th>Gravity dam</th></tr>
<tr><td>Foundation</td><td>The can be founded on any type of soil</td><td>They cannot be founded on any on any soil without proper foundation.</td></tr>
<tr><td>Seepages</td><td>Seepage is more</td><td>Seepage is less</td></tr>
<tr><td>Construction Material</td><td>Locally available soil stone silt clay and sand can be used.</td><td>Stone brick and concrete only can be used.</td></tr>
<tr><td>Length of dam</td><td>Cannot construct for shorter length.</td><td>Can be constructed for short length.</td></tr>
<tr><td>Construction method.</td><td>Construction is easy</td><td>Construction is not easy.</td></tr>
<tr><td>cost</td><td>Initial cost is less</td><td>Initial cost is high</td></tr>
<tr><td>manpower required</td><td>Skilled labours are not required for construction.</td><td>Skilled labours are required for construction.</td></tr>
<tr><td>Maintenance</td><td>Maintenance cost is more</td><td>Maintenance cost is less</td></tr>
</table></td><td>1 Mark Each</td></tr>
</table>

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**c)**	**Suggest the suitable type of CD work and draw the sketch of it under each situation.** **i) Canal bed level and Nala Bed level are same** **ii) Canal bed level is above HFL of Nala** **iii)Nala bed level is above FSL of Canal** **iv) HFL of Nala is in between FSL of canal and bed level of canal**		
	Ans.	**i) Canal bed level and Nala Bed level are same**  **Fig: Level Crossing**	**2M**	
		ii) Canal bed level is above HFL of Nala  **Fig: Aqueduct**	**2M**	
		iii) Nala bed level is above FSL of canal  **Fig: Super Passage**	**2M**	**8M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**c)**	**iv) HFL of nala is between FSL of Canal and bed level of canal**  **Fig: Siphon Aqueduct**	**2M**	
Q.6		**Attempt any <u>FOUR</u> of the following:**		**16M**
	a)	**Differentiate between head regulator and cross regulator on four points.**		
	Ans.		**1 Mark each**	**4M**

Head regulator	Cross regulator
These are constructed at off take point	These are constructed in main canal or parent canal at d/s side of off take canal.
It regulate the supply of off taking canal	It regulate the supply in parent canal
It control the silt in off taking canal	Already silt controlled by head regulator.
It helps in shutting off the supplies when not needed in off taking canal or when off taking canal is required to close for repair.	It helps in closing the supply to d/s of parent for close to repair.

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**b)** **Ans.**	**Draw the neat sketch of diversion headwork and show component parts of it.**  	**3 Mark for diagram and 1 Mark for labeling**	**4M**
	c) **Ans.**	**Draw the cross section of canal in partial cutting.**  C/S OF CANAL IN PARTIAL CUTTING & EMBANKMENT (Canal bank level is below G.L. but FSL is above G.L.)	**3 Mark for diagram And 1 mark for labeling**	**4M**
	d) **Ans.**	**Compare between contour canal and Ridge Canal.**	**1 Mark each (any four)**	**4M**

Sr. No	Contour canal	Ridge Canal.
1	Can irrigate only one side	Can irrigate only both side
2	Contour canal is not economical	Ridge canal is economical
3	Large number of cross drainage works	No cross drainage is required
4	Velocity of water needs not to be controlled.	Velocity of water needs to be controlled.
5	Less Scouring of bed	Scouring of bed due to higher velocities
6	Suitable in hilly areas	Not Suitable in hilly areas

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**e) Ans.**	**Compare between aqueduct and super passage.**	**1 Mark each (any four)**	**4M**

Sr. No	Aqueduct	Super passage
1	The irrigation structure constructed for passing the canal water safely over the drainage water is called aqueduct.	The hydraulic structure in which the drainage is passing over the irrigation canal is known as super passage.
2	Bed level of canal is sufficiently above the high flood level in the drain.	This structure is suitable when the bed level of drainage is above the flood surface level of the canal.
3	The discharge through drain is more than canal discharge.	The discharge through canal is more than drain discharge.
4	The section of canal is design as per FSL with sufficient Free Board	A free board of about 1.5 m should be provided for safety.
5	The water of the drain passes clearly below the canal.	The water of the canal passes clearly below the drainage.