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.

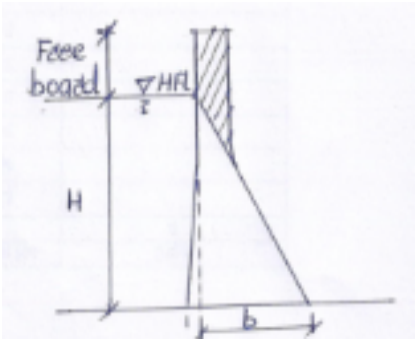
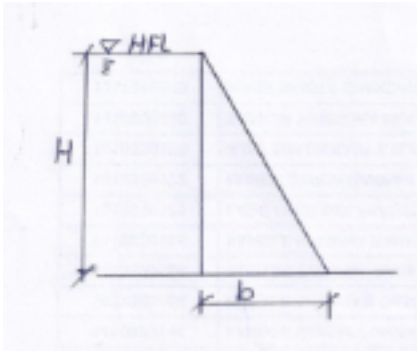
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
1		**Attempt any TEN**		**20**
	(a) Ans.	**Define water spread area.** This is the spread of reservoir on the upstream side of the dam at HFL. All the land within HFL contour is acquired & people are not allowed to stay within it. It is also called as Submergence area.	**2 M**	**2 M**
	(b) Ans.	**Define crop rotation.** The nature of crop sown in a particular field is changed one after other in the same field is known as "Crop Rotation".	**2 M**	**2 M**
	(c) Ans.	**Define 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.	**2 M**	**2 M**
	(d) Ans.	**State the meaning of yield of drainage basin.** Yield of drainage basin is defined as, the total quantity of water available from a catchment area at the outlet in the period of one year.	**2 M**	**2 M**
	(e) Ans.	**State any two purposes of canal lining.** The canals are lined for the following purposes – 1) To reduce the seepage losses in canal. 2) To prevent scouring of bed sides. 3) To economies the construction of canal. 4) To improve the discharge of canal by increasing the velocity of flowing water.	**1 M each (any two)**	**2 M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
1	**(f) Ans.**	**Enlist any four types of material used for canal lining.** Following are the different materials used for canal lining – (1) Cement concrete (2) Cement Mortar (3) Brick (4) Stone (5) Asphalt (6) Impervious Soil	**1/2 M each (any four)**	**2 M**
	(g) Ans.	**State any two limitations of Bhandhara Irrigation.** Following are the limitations of Bhandhara Irrigation – 1) The irrigable area is fixed & hence even if more quantity of water is available for irrigation it cannot be utilized. 2) There may be uncertainty of supply of water in case of Non-perennial river.	**1 M each**	**2 M**
	(h) Ans.	**State any two advantages of Bhandhara Irrigation.** Following are the advantages of Bhandhara Irrigation – 1) The system of irrigation is economical. The irrigable area is compact, irrigation is intensive, length of canal is less, and transit losses are also less. All these factors lead to high duty of water. 2) The water of small catchments which would otherwise have gone waste is fruitfully utilized.	**1 M each**	**2 M**
	(i) Ans.	**State any two advantages of spillway gates in dam.** Following are the advantages of spillway gates in dam :- 1) Saving in height of dam 2) Saving in land acquisition 3) More useful storage for the same height of dam 4) Reduction in the length of spillway & saving in cost	**1 M each (any two)**	**2 M**
	(j) Ans.	**Classify Irrigation project based on purpose with one example each.** Purpose wise classification of irrigation project is as follows : <u>1) Single Purpose Project :</u> A project planned for one or single purpose is called as single purpose project e.g. Koyana project for hydropower, Gangapur project for irrigation etc. <u>2) Multipurpose Project :</u> A project planned for more than one purpose is called as multipurpose project. e.g. Bhakra Nangal project for irrigation & hydropower generation, Jayakwadi project for irrigation & hydropower generation etc.	**1 M** **1 M**	**2 M**
	(k) Ans.	**State any two ill effects of Irrigation.** Following are the ill effects of irrigation :- 1) Water logging 2) Salt efflorescence due to water logging 3) Breeding of mosquitoes 4) Damp climate 5) Excessive humidity 6) Ecological imbalance	**1 M each (any two)**	**2 M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
1	**(l)**	**Define command area.**		
	Ans.	The area on downstream side of a project to which water can reach by gravity is called as command area.	**2 M**	**2 M**
	(m)	**Define flood absorption capacity.**		
	Ans.	This is the volume of water in the reservoir between HFL & FRL. When the flood absorption capacity is large, maximum flood water may be temporarily stored in the reservoir between FRL & HFL. This has the effect of reduction of MFD & consequently requires lesser length of the spillway.	**2 M**	**2 M**
2		**Attempt any FOUR.**		**16**
	(a)	**Enlist any eight advantages of irrigation.**		
	Ans.	Following are the advantages 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	**1/2 M each (any eight)** **4 M**	
	(b)	**List any eight factors affecting on duty.**		
	Ans.	Following are the different factors affecting on duty :- 1) Method & system of irrigation 2) Mode of applying water 3) Method of cultivation 4) Time & frequency of tilling 5) Type of crop 6) Base period of crop 7) Climatic condition of area 8) Quality of water 9) Method of assessment 10) Canal condition 11) Character of soil & sub-soil of the canal 12) Character of soil & sub-soil of the irrigation field	**1/2 M each (any eight)** **4 M**	

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>2</td><td>(c)

Ans.</td><td>Differentiate between practical profile & theoretical profile of dam with sketch.

<table>
<tr><th>Practical Profile</th><th>Theoretical Profile</th></tr>
<tr><td>1) It is a practical profile which is actually provided in practice.</td><td>1) It is only a theoretical profile.</td></tr>
<tr><td>2) There is some free board.</td><td>2) There is no free board.</td></tr>
<tr><td>3) There is top width.</td><td>3) There is no top width.</td></tr>
<tr><td>4) Above HFL, some free board is provided to avoid overtopping.</td><td>4) The apex of the dam is at HFL.</td></tr>
<tr><td>5) Sketch
 
</td><td>5) Sketch
 
</td></tr>
</table>

Explain how percolation tank differs from Irrigation tank.
<u>Percolation Tanks :- For percolation tank, the bed should be pervious.</u> They are constructed at suitable site by providing earthen bunds. The water from it percolates through the tank bed & joins the ground water table. It raises the water level of the following existing wells. The water is then pumped for irrigation. Thus it is an indirect system of irrigation.
<u>Irrigation Tank :-</u> For irrigation tank, the bed should be impervious. It is constructed where the basin is watertight. It is constructed on river where the narrow valley portion is available. Water is stored on upstream side of the dam & then it is released as per the requirement for irrigation through canals. Thus it is direct system of irrigation.</td><td>1 M each (any three)

1 M

2 M

2 M</td><td>4 M

4 M</td></tr>
</table>

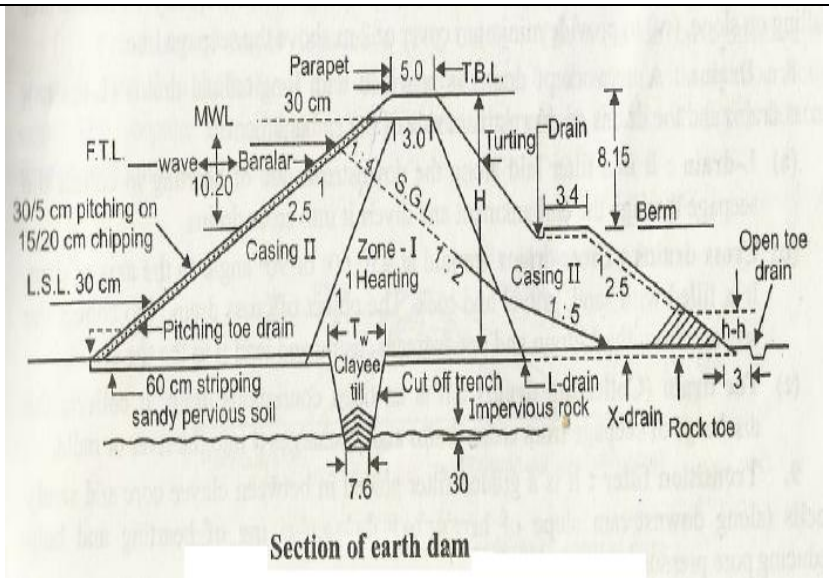
<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>2</td><td>(e) Ans.</td><td>Distinguish between weir & barrages.
<table>
<tr><th>Point</th><th>Weir</th><th>Barrage</th></tr>
<tr><td>1) Crest Level</td><td>Crest level is below HFL. In some cases it is at FSL</td><td>Crest level is at river bed level</td></tr>
<tr><td>2) Afflux</td><td>It gives high afflux.</td><td>It gives low afflux.</td></tr>
<tr><td>3) Ponding of water</td><td>The entire ponding of water is achieved by gates.</td><td>Most of the ponding is done by gates & a smaller or nil part of it is done by raised gates.</td></tr>
<tr><td>4) Clearance of flood</td><td>No control on floods.</td><td>During floods gates are raised to clear off the high flood & thus there is control on floods.</td></tr>
<tr><td>5) Silting</td><td>There is more silting.</td><td>There is less silting.</td></tr>
<tr><td>6) Maintenance</td><td>Maintenance of weir is comparatively easy & cheap.</td><td>Maintenance of barrage is difficult.</td></tr>
</table></td><td>1 M each (any four)</td><td>4 M</td></tr>
<tr><td></td><td>(f)

Ans.</td><td>Design the section of an unlined channel from following data :
Q = 60 m^3/sec, V = 1.2 m/sec, B/D = 6, N = 0.0225
<u>NOTE :-</u>
1) In this problem, it is not mentioned whether to design Rectangular section or Trapezoidal section.
2) If it is to be designed as Trapezoidal section, side slope is not given.
3) According to assumption answer may vary.

Case I : Assuming Rectangular Section
$Q = A.v$
Hence, area of channel (A)
$A = \frac{Q}{v} = \frac{60}{1.2} = 50m^2$</td><td>1 M</td><td></td></tr>
</table>

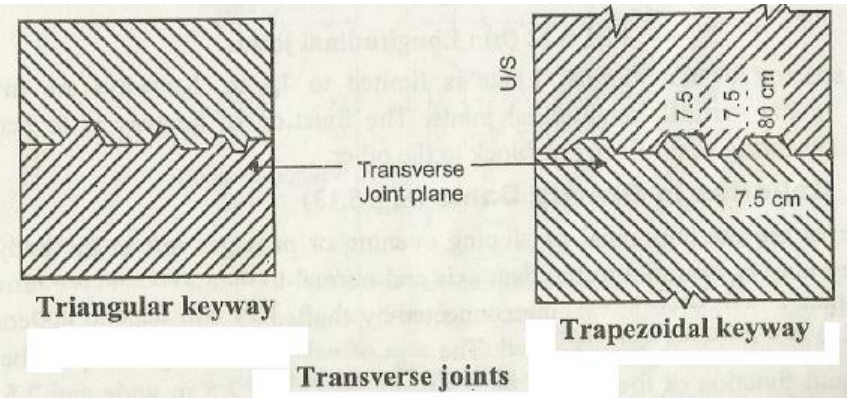
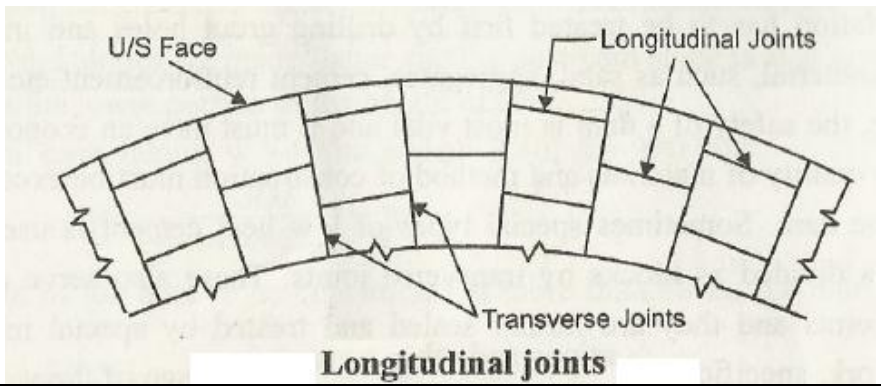
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2		We also have, A = b. d = BXD ----------(1) But, B/D = 6 or B = 6D Substituting values of A & B in equation (1) 50 = (6D X D) $50 = 6\ D^2$ **D = 2.88 m** B = 6 D = 6 X 2.88 **B = 17.28 m** Wetted perimeter (P) P = B + 2 D = 17.28 + (2 X 2.88) = 23.04 m Hydraulic radius (R) = A/ P = 50 / 23.04 = 2.17 m Using Manning's formula $v = \frac{1}{N}(R^{2/3})(S^{1/2})$ $1.2 = \frac{1}{0.0225}(2.17^{2/3})(S^{1/2})$ $1.2 = 74.494(S^{1/2})$ $(S^{1/2}) = 0.01611$ $S = \frac{1}{3853.08} \approx \frac{1}{3900}$ **S = 1 / 3900** **OR** **Case II : Assuming Trapezoidal Section** Assuming side slope of 2:1 Hence, n = 2 $Q = A.v$ Hence, area of channel (A) $A = \frac{Q}{v} = \frac{60}{1.2} = 50m^2$ We also have, $A = (b + nd)d$ ----------(1) Putting values of b, n & d $A = (B + 2D)D$	**1 M** **1/2 M** **1/2 M** **1/2 M** **1/2 M** **1 M** **1 M**	**4 M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2		But, B/D = 6 or B = 6D Substituting values of A & B in equation (1) $50 = (6D + 2D)\ D$ $50 = 8\ D^2$		
		D = 2.5 m	**1/2 M**	
		B = 6 D = 6 X 2.5 **B = 15 m**	**1/2 M**	
		Wetted perimeter (P) $P = (b + 2d\sqrt{n^2 + 1})$ $P = (15 + 2X\,2.5\sqrt{2^2 + 1})$ $P = 26.180m$		
		Hydraulic radius (R) = A/ P = 50 / 26.180 = 1.91 m		
		Using Manning's formula $v = \frac{1}{N}(R^{2/3})(S^{1/2})$	**1/2 M**	
		$1.2 = \frac{1}{0.0225}(1.91^{2/3})(S^{1/2})$ $1.2 = 68.418(S^{1/2})$ $(S^{1/2}) = 0.01754$ $S = \frac{1}{3250.43} \approx \frac{1}{3300}$		
		S = 1 / 3300	**1/2 M**	**4 M**
3		**Attempt any TWO.**		**16 M**
	(a)	**Draw a typical cross section of Earthen Dam showing all it's components and state the functions of any four components.**		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
3	Ans.	 Section of earth dam	**2 M for figure & 2 M for labe-lling**	**8 M**

Component Part	Function
Rock toe	1) To prevent slogging of toe due to seepage. 2)To increase stability of dam.
Pitching	1) To prevent erosion of u/s face from wave action. 2)To protect slope from sudden drawdown.
Turfing	To protect d/s slope from eroding action of rain water.
Berms	1) To collect rain water & dispose off safely. 2) To provide roadway for vehicles. 3) To reduce velocity of rainwater falling on slope. 4) To provide minimum cover of 2 m above seepage line.
Transition filter	1) To help in draining of hearting. 2) To help in reducing pore pressure.
L – Drain	To collect seepage through embankment & divert it into cross – drains.
Cross Drain	To collect seepage from L – Drain & divert it into toe drain.
Toe drain	To collect discharge through cross drain & divert it into river.

1 M for each comp-onent with one func-tion (any four)

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
3	**(b)**	**State the joints used in construction of Gravity dams. Explain the joints with sketches.**		
	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.	**2 M**	
		(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	**1 M**	
		(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.	**1 M**	
			**1 ½ M**	
		(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.	**1 M**	
			**1 ½ M**	**8 M**

3 (c) Ans. **State the various cropping seasons in Maharashtra. State with their period & common crops taken.** — **8 M**

Following are the different cropping seasons in Maharashtra :- — **2 M for each (any four)**

Season	Period		Base Period (days)	Common crops taken
	From	To		
Kharif	15th June	14th Oct.	123	Rice, Bajari, Jowar
Rabbi	15th Oct	14th Feb	122	Wheat, Linseed, Gram
Hot Weather	15th Feb	14th June	120	Vegetables
Eight Monthly	15th June	14th Feb	245	Cotton, Tur, Ground nut
Perennial / Annual	15th June	14th June	365	Sugarcane, Orchards

4 **Attempt any FOUR.** — **16**

(a) Ans. **State the factors which affect runoff & maximum flood discharge.** — **4 M**

Following are the different factors which affect runoff & maximum flood discharge :- — **1 M each (any four)**

1) Rainfall & its quantity : More the rainfall, runoff will be more & thus maximum flood discharge will be more.

2) Intensity of rainfall : More the intensity of rainfall, More will be the runoff & maximum flood discharge.

3) Direction of wind : If wind direction is in an upstream side of the site, maximum flood discharge will be less & if it is in downstream side, maximum flood discharge will be more.

4) Temperature : More the temperature, runoff will be less & thus maximum flood discharge will be less & viceversa.

5) Characteristics of catchment :
- Rocky strata – heavy runoff & more maximum flood discharge
- Compactive strata - heavy runoff & more maximum flood discharge
- Sandy strata – reduced runoff & less maximum flood discharge

6) Topography of the catchment :-
- Catchment area – Larger the area, more runoff & maximum flood discharge
- Steep slopes – Heavy runoff will reach the valley quickly, reducing losses gives more runoff & maximum flood discharge.

(b) Ans. **Derive a relation between Duty, Delta & Base period.** — **1 M**

Let's, D = Duty in Ha / cumec
Δ = Delta in meters
B = Base period in days

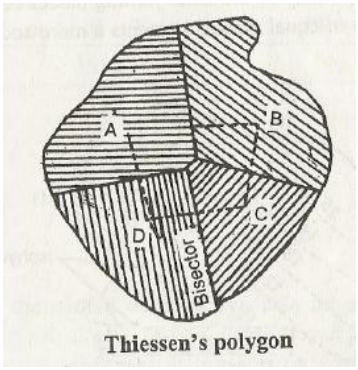
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
4		1) If we take a field of area D Ha, water supplied to field corresponding to water depth of Δ meters = Δ X D X 10^4 cubic meter = Δ X D X 10^4 m^3 ----------(1) 2) Again for same field of D Ha, one cumec of water is required to flow during the entire base period. Hence, water supplied to this field = = 1 X B X 24 X 60 X 60 m^3 ----------(2) Equating, (1) and (2) Δ X D X 10^4 = 1 X B X 24 X 60 X 60 $\Delta = \frac{BX86400}{DX10^4}$ $\Delta = (8.64)\frac{B}{D}$ *OR* $D = (8.64)\frac{B}{\Delta}$	**1 M** **1 M** **1 M**	**4 M**
	(c). **Ans.**	**State the purpose of spillway in a dam. Name the different types of spillway.** Purpose of spillway : - The purpose of spillway is to effectively dispose off the surplus quantity of water from upstream to downstream side of the reservoir. Different types of spillway : 1) Main / Service spillway (1.a) Ogee spillway (1.b) Bar spillway (1.c) Side channel spillway (1.d) Trough / Chute spillway (1.e) Shaft spillway 2) Emergency Spillway	**2 M** **1/2 M each (any four)**	**4 M**
	(d) **Ans.**	**State the four advantages of Drip Irrigation.** Following are the different advantages of drip irrigation :- 1) This method eliminates evaporation losses which are prominent in sprinkler & surface irrigation. 2) As compared to surface irrigation this method needs nearly 25 % water to mature a crop. 3) Frequent ploughing is not required as the surface does not become hard. 4) Though this method is more expensive than sprinkler system, but it is the best method of irrigation with ground water in arid zones where soils are of poor structure & have high salt contents. 5) In this system of irrigation, water deficit in the soil never occurs. 6) Due to constant wetting of the soil around the root zone, the high concentration of salts in the root zone does not occur.		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
4		7) This method has been found to be very useful in reclaiming & developing desert area. 8) Experiments have shown that the yield of crops due to this system has increased substantially & in some cases even more than double yield has been obtained in comparison to other methods of irrigation.	**1 M each (any four)**	**4 M**
	(e) Ans.	**What is meant by weir? State the different types of weir.** A weir is an impervious barrier constructed across a river to raise its water level on its upstream side & divert the water into the canal taking off from its upstream side. The top of weir is kept below HFL at weir side & hence the water flows over its entire top or crest. Sometimes, the top of weir is kept at FSL also. Types of weirs :- 1) Masonry weirs with vertical drop 2) Rock-fill weirs with sloping aprons 3) Concrete weirs with sloping downstream glacis	**2 M** **2 M**	**4 M**
	(f) Ans.	**State the points to be considered while fixing alignment of canal.** Following points should be considered while fixing the alignment of canal:- 1) Along the alignment of canal, the cross – drainage works should be minimum. 2) The alignment of canal should be such that, water should flow under gravity. 3) The canal alignment should be such that, the quantity of earthwork in cutting should be equal to the quantity of earthwork in filling. 4) The alignment of canal should be such that, it can cover maximum command area.	**1 M each**	**4 M**
5		**Attempt any FOUR.**		**16**
	(a)	**Differentiate between surface irrigation & lift irrigation.**		
	Ans.			

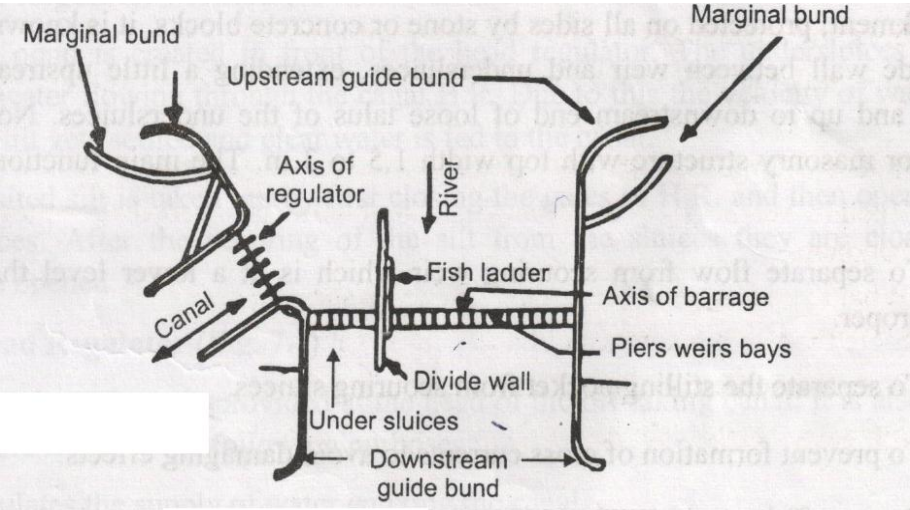
Surface Irrigation	Lift Irrigation
1) It is surface flow.	1) It is sub-surface flow.
2) Flow is under gravity.	2) Flow is under pressure.
3) Evaporation losses are more.	3) Evaporation losses are less.
4) Lifting devices are not required to lift the water.	4) Lifting devices are required to lift the water.

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>5</td><td></td><td>Continued ----

<table>
<tr><th>Surface Irrigation</th><th>Lift Irrigation</th></tr>
<tr><td>5) There is no control on water supply.</td><td>5) There is proper control on water supply.</td></tr>
<tr><td>6) Surface irrigation is possible only where canals are passing.</td><td>6) Lift irrigation is possible at any desired place by boring the well.</td></tr>
<tr><td>7) Supply of water does not depend upon power.</td><td>7) Supply of water depend upon power.</td></tr>
<tr><td>8) Irrigation capacity is large.</td><td>8) Irrigation capacity is small.</td></tr>
<tr><td>9) There may be wastage of water.</td><td>9) In this method, water can be used economically.</td></tr>
<tr><td>10) Initial investment cost is comparatively more.</td><td>10) Initial investment cost is comparatively less.</td></tr>
<tr><td>11) Maintenance cost is less.</td><td>11) Maintenance cost is more.</td></tr>
<tr><td>12) Chances of water logging are more.</td><td>12) Chances of water logging are less.</td></tr>
<tr><td>13) Irrigation area is larger.</td><td>13) Irrigation area is smaller.</td></tr>
</table></td><td>1/2 M each (any eight)</td><td>4 M</td></tr>
<tr><td></td><td>(b) Ans.</td><td>State the considerations for the selection of a site for Bhandhara.
Following points should be considered while selecting a site for Bhandhara :-
1) It should be near the area to be irrigated.
2) It should be preferably below the confluence of two or more streams to have good supply of water.
3) It should be preferably be just on upstream side of steep bed slope.
4) The section of a stream at the site should be straight, narrow & well defined.
5) Good foundation should be available for the construction of bhandhara.
6) The cost of construction should be within yard stick.</td><td>1 M each (any four)</td><td>4 M</td></tr>
</table>

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
5	**(c)**	**Explain Thiessen's polygon method for calculating the average rainfall.**		
	Ans.	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, D representing the area as shown in figure.	**1 M**	
		 Thiessen's polygon	**1 M**	
		1) Join the adjacent rain gauge stations A, B, C, 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, A_1, A_2, -------A_n = Area P_1, P_2, --------P_n = Average rainfall of that station	**1 M for proce-dure**	
		$$P_{av} = \frac{A_1 p_1 + A_2 p_2 + A_3 p_3 + - - - - - - + A_n p_n}{A_1 + A_2 + A_3 + - - - - - - + A_n}$$ $$P_{av} = \frac{\sum AXp}{\sum A}$$	**1 M**	**4 M**
	(d)	**A tank has a catchment area of 150 km^2 of which 30 km^2 is independent. The average annual rainfall of the catchment is 85 cm. The runoff of average bad year is 20% of the rainfall for an average bad year. The runoff from the intercepted catchment available for this tank is 20% of actual runoff. Calculate the assured yield.**		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
5	**Ans.**	Total C. A. = 150 km^2 Independent C. A. = 30 km^2 Intercepted C. A. = 150 – 30 = 120 km^2 Average annual rainfall = 85 cm Bad year is called when annual rainfall is less than 80 % of the average annual rainfall. Rainfall of bad year = 80 % of Average annual rainfall = (80 / 100) X 85 = 68 cm Runoff of average bad year from Independent C. A = 20 % of Rainfall of bad year = (20 / 100) X 68 = 13.6 cm Runoff of average bad year from Intercepted C. A = 20 % of Runoff of average bad year from Independent C. A = (20 / 100) X 13.6 = 2.72 cm Yield from independent C. A = Independent C. A. X Runoff from Independent C. A = 30 X 13.6 = 408 ha.m Yield from intercepted C. A = Intercepted C. A. X Runoff from intercepted C. A = 120 X 2.72 = 326.4 ha.m Total Yield = 408 + 326.4 = 734.4 ha.m **Total Assured Yield = 734.4 ha.m**	**1 M** **1/2 M** **1/2 M** **1/2 M** **1/2 M** **1 M**	**4 M**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
5	**(e) Ans.**	**Draw a layout of typical barrage & show all component part of it.** Following figure shows a layout of typical barrage with its components – **<u>NOTE :</u> Here layout of typical barrage is nothing but layout of Diversion Head Work.**  **Layout of Diversion Head Work**	**2 M for figure & 2 M for labe-lling**	**4 M**
	(f) Ans.	**Enlist the various data required for calculation of design discharge.** Following data is required for calculation of design discharge :- 1) Type of season 2) Type of crop 3) Culturable Command Area (C.C.A) 4) Duty (D) 5) Base period (B) 6) Delta (Δ) 7) Losses of water 8) Time factor 9) Capacity factor	**1/2 M each (any eight)**	**4 M**
6		**Attempt any FOUR.**		**16**
	(a) Ans.	**State four advantages of lining of a canal.** Following are the different advantages of a canal lining :- <u>1) Reduction in seepage losses –</u> The seepage losses are substantially reduced by providing lining. Thus water saved can be used to irrigate more area in the command.		

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>6</td><td></td><td>2) Higher velocities can be permitted – The lining affords higher velocity of flowing water in the canal. Due to smooth surface, the roughness is reduced.
3) Reduction in water logging – Seepage through unlined canal is the main source of water logging. This is minimized by providing lining of canals.
4) Steeper bed slope can be provided - The canal bed slope can be made steeper which increases the velocity of flowing water & reduces evaporation losses. The water reaches to the land quickly.
5) Reduction in maintenance cost - The lined canal will have less annual maintenance since the growth of weeds, silt etc. can be minimized.</td><td>1 M each (any four)</td><td>4 M</td></tr>
<tr><td></td><td>(b) Ans.</td><td>State the properties of good lining material.
Following are the different properties of good lining material :
1) Water tightness
2) Low cost & subsequent less maintenance cost
3) Strength & durability
4) Prevention of weeds growth
5) Ease of constructing with local material</td><td>1 M each (any four)</td><td>4 M</td></tr>
<tr><td></td><td>(c)

Ans.</td><td>Give functions of the following :
i) Divide wall ii) Scouring sluices
ii) Fish ladder iv) Stilling pond

<table>
<tr><th>Component Part</th><th>Function</th></tr>
<tr><td>i) Divide wall</td><td>1) To separate flow from scouring weir
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.</td></tr>
<tr><td>ii) Scouring sluices</td><td>To remove the deposited silt & soil.</td></tr>
<tr><td>iii) Fish ladder</td><td>1) To reduce velocity of water.
2) To allow the fishes to go from u/s to d/s or vice-versa.</td></tr>
<tr><td>iv) Stilling pond</td><td>1) To reduce velocity of water.
2) To settle down the silt & allow clear water to the canal.</td></tr>
</table></td><td>1 M each for one func-tion</td><td>4 M</td></tr>
</table>

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
6	**(d) Ans.**	**State merits of Gravity dam over Earthen dam.** Following are the merits of Gravity dam over Earthen dam :- 1) Comparatively there is less seepage through gravity dam. 2) Diversion of flow during construction of dam is not that much costly as that of earthen dam. 3) Life is more. 4) Maintenance cost is less.	**1 M each**	**4 M**
	(e) Ans.	**Enlist the various forces acting on Gravity Dam.** Following forces acts on a gravity dam – 1) Water pressure on upstream side 2) Water pressure on downstream side 3) Weight of dam 4) Upstream silt pressure 5) Seismic forces 6) Uplift force 7) Ice pressure 8) Wave pressure.	**1/2 M each**	**4 M**
	(f) Ans.	**Discuss the relative merits & demerits of sprinkler irrigation.** <u>Merits of sprinkler irrigation –</u> 1) Erosion of land can be minimized. 2) Uniform application of water is possible 3) Leveling of land is not required. 4) Elimination of seepage & percolation losses thus prevent water logging. 5) Fertilizers can be applied in solution form along with irrigation water from the sprinklers. 6) This method stimulates the rainfall conditions & its efficiency ranges from 80 to 90 %. 7) More land is available for irrigation as borders, ditches etc. are minimized. 8) Small streams of irrigation water can be used effectively. <u>Demerits of sprinkler irrigation –</u> 1) Uniformity of irrigation is not achieved when wind velocity is more than 16 km/hour. 2) Initial cost of sprinkler set is high. 3) Sprinklers are not suited for crops requiring frequent large depth of irrigation as in case of banana, paddy etc. 4) A constant supply of water is needed for economical use of equipment. 5) Water must be clean & free from sand etc. **6)** The power requirement is high.	**1 M each (any two)** **1 M each (any two)**	**4 M**