10/05/17 ✓ Scoring Indicators (15) 4012 II

Code :4012 Version:2015 B.

Qn. No.	Scoring Indicators	Split score	Total score
	Part – A		
	I.		
	1. Irrigation may be defined as the process of artificially supplying water to soil for rising crops. It is the field of engineering that controls the various natural sources of water, by constructing dams, reservoirs, canals etc and distributing the water to the agricultural fields.		
	2. Non recording type rain gauges.		
	Automatic rain gauges.		
	Non recording type rain gauge.:- Symon's rain gauge is the most common one.		
	Automatic rain gauges.		
	Float type rain gauge		
	Weighing bucket rain gauge		
	Tipping bucket rain gauge		
	3. Fish ladder:- across the river if a dam is constructed the passage is totally blocked by the masonry wall hence the movement of the fish is also obstructed. The structure provided for the movement of the fish from one side of the river to the other side is called fish ladder. The fish ladder is situated near the under sluices where there is always some water in the river section.	5×2	10
	4. Surplus escape:- water is stored in a tank up to full tank level. The excess water entering the tank during rains and floods is disposed off by means of surplus arrangements. They are either weirs or flush escapes.		
	5. When the canal bed level is higher than the bed level of the river, the cross drainage work constructed is known as an aqueduct.		
	Part - B		
	II. 1.		
	- Contour bunding, contour tilling, contour sowing		
	- By growing trees which obstruct wind velocity.		
	- Crops should be selected such that they cover the soil and prevent beating of rain.	6×1	6
	- Rotation of crops and mixed crops prevent soil erosion.		
	- Providing outlets to reduce the velocity of water.		
	- Afforestation of catchment area.		
	2. Advantages and disadvantages.		
	All irrigation schemes are so designed that they increase the food production of the country. Apart from this there are many advantages like-	Ad: 3 Disad: 3	6
	Increase in food production:- due to the controlled supply of water the yield is		

increased.

Protection from famine:- during the construction of irrigation works people gets employment and thus get relief from famine and after that continuous water supply is maintained during drought.

Cultivation of cash crops:- crops like sugarcane , indigo, tobacco, cotton etc can be cultivated.

Elimination of mixed cropping:- mixed cropping has many disadvantages which may be overcome by irrigation.

Addition to the wealth of the country :- all irrigation projects bring some revenue to the country. In addition to the water tax, the bumper crops produced makes country self-sufficient in food requirements.

Improvement in ground water storage:- due to constant seepage of water , the ground water table is raised.

Increase in prosperity of the people:- due to the irrigation facility, the value of the land is increased, due to the increase in yield, the farmers become prosperous and thereby their living standard is increased.

Excess irrigation and unscientific use of irrigation water may give rise to the following disadvantages:-

Breeding places for mosquitoes:- due to excess application and leakage of water, ponds and depressions get filled up with water and create breeding places for mosquitoes.

Water logging:- due to over irrigation the ground water table rises and saturates the crop root zone completely and whole area becomes water logged.

Damp climate:- the area become damp and cold due to irrigation.

3.

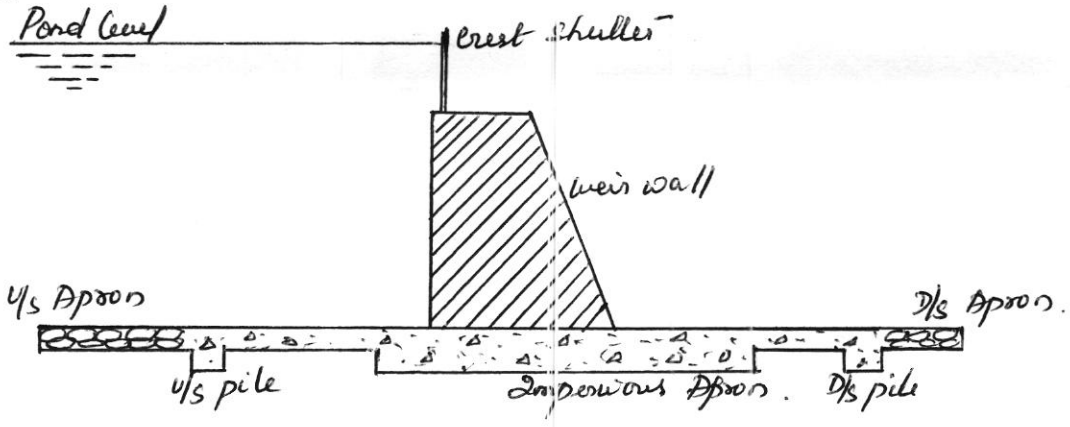

fig: 3
parts: 3

6

4. The water which penetrates in the ground and does not join the runoff water, comes under percolation losses. This loss mainly depends on the nature of the strata underlying the surface soil and the sub-soil. If the ground is of an impervious nature and free from cracks and joints, there will be no loss due to percolation. But on the other hand, if the rocks are permeable having cracks and faults, the percolation losses will be more.

3 + 3

6

PTO.

Effects:-

- The water may carry with it soil particles and cause erosion and undermine the structure - piping
- The water percolates into the foundation & creeps through the joint.
- The water exerts an upward pressure resulting in Rupture.

Remedies:-

- providing impervious floor of sufficient length and thickness.
- providing piles at the upstream end to reduce uplift pressure.

5. Majority of Indians depend upon agriculture. In India weather conditions vary from state to state. North Indian states are cooler whereas south Indian states are hotter.

There are two main crop seasons in India.

Kharif season:- this season starts from 1st week of April and ends in the last week of September. A mild rain is required during the last week of March to make the soil loose for ploughing.

3+3 | 6

Rabi season:- this season starts from the 1st week of October and ends in the last week of March. A small intensity rainfall is necessary during the last week of September for ploughing the soil.

- 6. Over topping- if the water level in the reservoir rises to such a height that it flows over the top of the earth dam failure due to erosion takes place. Sometimes if spillway capacity is insufficient or if the free board is insufficient or if the foundation settles it may lead to over topping.

3×2 | 6

- Wave erosion:- if the upstream slope is not protected properly, waves, rain and wind may scoop out the earth and cause erosion on the upstream side. The slope becomes steep due to erosion and slipping of the upper layers occur.

Toe erosion:- occur due to -erosion due to tail water.

-erosion due to cross currents. If the spillway or surplus weir is too close to the earth dam the discharging water may erode toe of the dam.

Gullying:- due to heavy rainfall , gullies may be formed on the downstream slope which is normally unprotected.

7. River gauging or stream gauging is the process of measuring the river flow. It is the best method for measuring the runoff. The gauging of stream flow is required for planning an irrigation project. The daily flow of a stream for a single season with rainfall records will enable forecasting the runoff to a reasonable degree of accuracy. Stream gauging involves measurement of discharge of river or canal and also the depth of flow , the river water level or stage.

Def: 2
Exp: 4 | 6

The floats are pieces of wood or hollow metallic cylinders, or bottles partly filled with water, coconuts and Palmyra fruits etc. AB is the starting line from which floats are released for each compartment. As soon as the float passes in a particular compartment just under the line AB , a stop watch is started. The observer walks along the bank upto the line EF. The time taken for this movement is noted. Several readings are taken and the average is noted. The length divided by the time taken in seconds gives the surface velocity. Since the mean velocity is less than the surface velocity , the surface velocity is multiplied by a factor 0.85 to get the mean velocity.

Part – C

Unit - I

III. (a)

India is basically an agricultural country, and all its resources depend on the output of agriculture. So the necessity for irrigation in our country can be summarized as

follows:-

Less rainfall:- When the total rainfall is less than the needed, artificial supply becomes necessary.

Irrigation works may be constructed where more water is available and conveyed to the deficiency areas. Eg:- Rajasthan canal.

Non uniform rainfall:- The rainfall in a particular area may not be uniform over the crop period. Rain may be available during the early period of the crop, but may not be available at the end. As a result, either the yield may be less or the crops may even die altogether. Here the water is collected during the excess rainfall period and supplied during the scanty periods.

4pts × 2 | 8

Growing a number of crops during a year:- The rainfall in an area may be sufficient to raise only one type of crop during the rainy season, ie, Kharif crops, for which no irrigation may be required. However with the provision of irrigation facilities in that area, crops can be raised in other seasons also, ie, Rabi crops.

Growing Perennial crops:- Perennial crops such as sugar cane which need water throughout the year, can be raised only through the provision of irrigation facilities in the area.

Commercial crops with additional water:- The rainfall in a particular area may be sufficient to raise the usual crops, but more water may be necessary for raising commercial and cash crops.

Controlled water supply:- By proper distribution of water, the yield of the crop may be increased because of controlled supply of water.

As Sri N D Gulati puts " Irrigation in many countries is as old an art, -as old as civilization – but for the whole world it is modern science – the science of survival."

(b) Methods and system of irrigation:- flow irrigation has low duty due to the conveyance losses, while lift irrigation has high duty due to the command area of each well is very near to it.

Mode of applying water:- flood irrigation has less duty than furrow irrigation.

Type of crop:- since the requirement of different crops vary, duty also varies. Crop requiring more water has less duty and vise versa. Duty for paddy is less than wheat.

Rainfall:- when there is rainfall water required for the crop will be less and the duty is high.

Soil characteristics:- if the soil is coarse grained seepage and percolation losses will be high, but in fine grained soils such losses will be less, hence duty will be higher.

7pts×1 | 7

Base period of the crop:- if the base period of the crop is more, the amount of water required will be high, hence duty will be more and vice versa.

Climatic conditions of the area:- the climatic conditions which affect duty are- temperature, wind, humidity and rainfall. Due to high temperature evaporation losses will be more and duty will be less. A humid atmosphere reduces the losses.

Quality of water:- if harmful salts and alkali content in water is more , more water has to be applied so that the salts are leached off, which reduces duty.

Canal conditions:- if the canal is unlined the seepage and percolation losses will be high resulting in low duty. But if the canal is lined the losses will be less and the duty will be high.

IV. (a)

An irrigation engineer should know about the occurance,distribution and movement of water on the earth. **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 the earth.

Hydrological cycle.

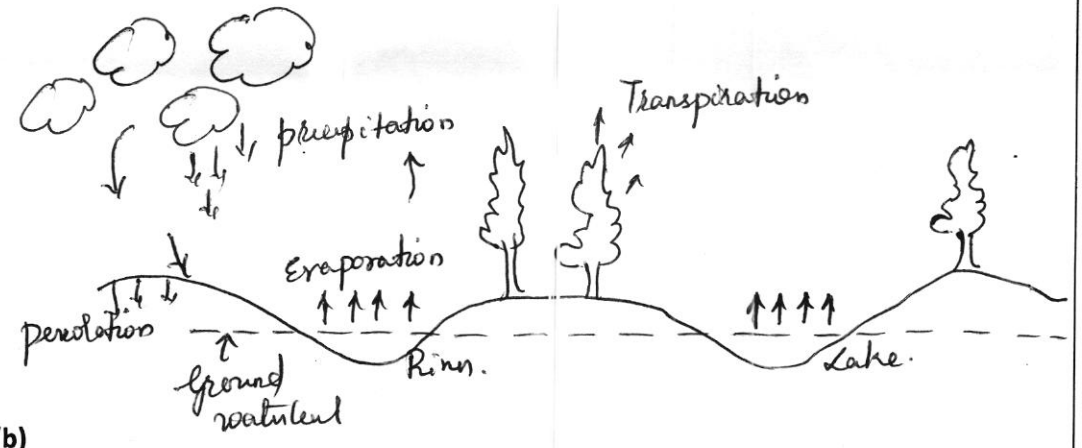

fig. 3 pts
expln - 5 8

(b)

Factors affecting runoff:-

Characteristics of the catchment area:- if the catchment area is having hills and rocky area, the seepage of water will be less and hence the runoff will be more. Similarly if the catchment area is having sandy and loose soil the seepage losses are more and runoff will be less.

Shape and size of the catchment area:- large catchment area contributes more runoff. If the shape of the catchment area is of fern type, the runoff is less. If it is fan shaped catchment, the area is more and naturally the run off is more.

- **Rainfall pattern:-** if the intensity of rainfall is more the runoff will be more and vice versa. If the duration of rainfall is short, it will not produce any runoff because the quantity of water fallen on the ground will be just sufficient for absorption into the soil.

any 6 pts 7

Topography:-

The rate of runoff depends upon the topography of the area. If the area is having steep slopes the rate of flow will be fast and more. If the area contains more pits and depressions or flatter slopes the flowing water will be intercepted and the runoff will be less.

Vegetation in the catchment area:- if the vegetation covers over a large area in the catchment area, it will reduce seepage losses thus increasing the rate of runoff.

Geological features of the area:- if the area is rocky, hard, the runoff will be increased. If the area is having cracks, the ground losses will be more and the runoff gets reduced.

Meteorological conditions:- runoff depends on the temperature prevailing in the area. The runoff will be more if the ground is in a saturated condition. If the temperature is high, runoff will be less because loss due to evaporation will be more.

Unit - II

V. (a)

Weir or anicut or barrage across the river:- a weir is a masonry structure constructed across a river to raise the water level so that water from the river can be diverted into the canal. Generally a weir is aligned at right angles to the direction of the flow of water in the river.

- Scouring sluices or under sluices:- these are the openings provided in the body wall of the weir generally at the bed level of the river near the off take canal. If there are two off take canals on both the sides , scouring sluices are provided on both the sides of the weir. They are used to remove the slit deposited in the bed of the river and also in front of regulator. The crest of sluice is kept at lower level than the crest of the weir. They are controlled by means of gates operated from top.

4×2 8

- Flood banks:- these are earthen banks provided on either side on upstream of the river to prevent flood water entering the neighboring areas and causing damage. Due to the construction of a weir across the river there will be rise in the maximum flood level (MFL) which is called afflux.

Works constructed at the head of a canal taking off from a river for the supply of water for irrigation purposes are known as head works.

(b)

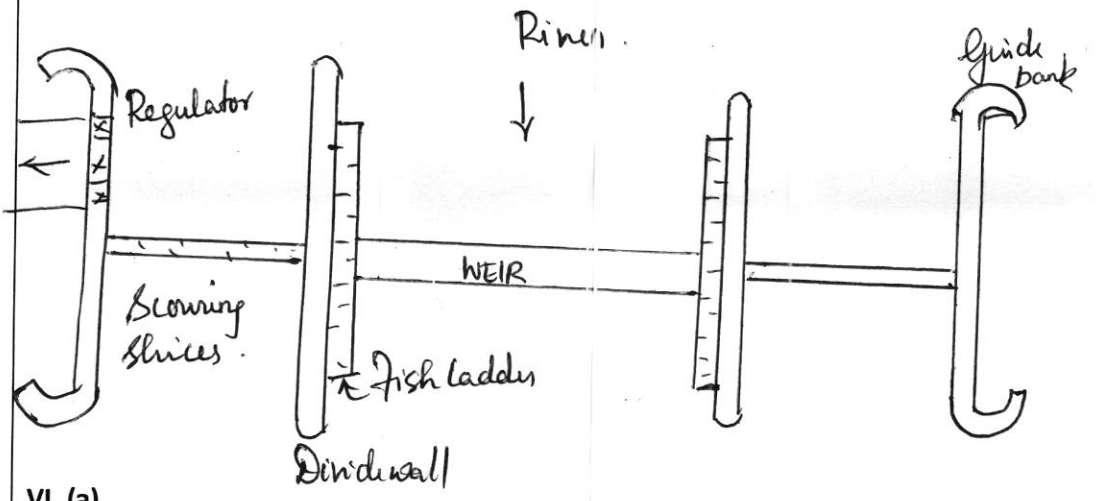

fig: 4 parts: 3 7

VI. (a)

- Body of the weir:- the body wall is constructed with masonry across the direction of flow to raise the water level on the upstream side. It should be strong enough to resist the water pressure and the uplift pressure from beneath the foundations.

Apron on the U/S side:- the length of the apron depends upon the discharge in the river and the weir length. The apron protects the main body of the weir from scouring action

of the water.

Apron on the D/S side:- the water falling over the weir from a height gains kinetic energy which will erode the D/S side of the river. The apron tries to destroy the kinetic energy. The length of the apron depends upon the height of the fall, nature of soil etc. Normally the apron is extended up to that point where there is no erosion.

U/S curtain wall:- this is mainly provided to reduce the uplift pressure.

D/S curtain wall:- it protects the D/S floor from uplift pressure. This is also necessary for keeping the exit gradients within the safe limits.

parts: 4
Explns: 4
8

Crest:- the top of the weir is known as crest. This must be sufficiently strong to resist the excessive water pressure during floods.

Shutters:- the shutters are provided on the crest of the weir to raise the water level of the river on the U/S side and divert it into the canal.

(b)

Scour:- when the natural water way of the river is contracted , the water may scour the bed both at upstream and downstream of the structure. The scour holes may extend towards the structure damaging the foundations if no remedial measures are taken.

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Remedies:-

Providing piles at upstream and downstream ends of the impervious floor much below the calculated scour level.

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Providing sufficient thickness of apron and suitable lengths both on the upstream side and downstream sides . The stones of the apron may settle in the scour holes.

4

Protective works like solid aprons and loose aprons are to be provided along the length of the creep.

Unit- III

VII. (a)

Following points should be considered while selecting site for reservoirs.

Should be selected in a narrow valley.

The bed should be impervious.

The site should have firm foundation.

The climate should be healthy.

Site should be accessible throughout the year.

The construction materials should be available at the site.

Site should have aesthetic beauty.

The site should be near to the irrigation area.

Any 8 pts
8

(b)

Dead load:- it includes weight of the concrete or masonry or both plus that of appurtenances such as piers, gates and bridges.

Water pressure (Reservoir and tail water loads):- water pressure corresponding to full reservoir level constitutes the major external force acting on the dam. The water pressure acts horizontally and the intensity varies triangularly with zero intensity at the water surface and equal to $WH^2/2$ at the base , where W is the unit weight of water ($1000kg/m^2$) and H is the upstream water depth.

Wave pressure:- the upper portion of the dam is subjected to the impact of waves, which are produced in water surface during winds.

7pts 7

Silt pressure:- the silt which is deposited in the reservoir, causes horizontal and vertical pressures depending upon the u/s face of the dam.

Uplift pressure:- it is the major external force acting upward due to seeping water. The uplift forces occur as internal pressures in pores, cracks and seams within the body of the dam , at the contact surface between the dam and its foundation and within the foundation. The water seeping through the cracks , pores and fissures of the foundation materials and the water seeping through the dam body and then to the bottom and its foundation at the base, exert an uplift pressure on the base of the dam. After water pressure , it is the second major external force on the dam. This force virtually reduces the weight of the dam.

Earthquake forces:- during earthquakes the waves are produced which are capable of shaking the earth upon which the dam is resting , in every possible direction.

Ice pressure:- at high altitudes the water reservoir gets covered with a sheet of ice. The thickness of the ice sheet depends on the temperature of the area. The dam face has to resist the thrust exerted by the expanding ice. This force acts along the length of the dam at the water or the reservoir level.

VIII. (a)

- Reconnaissance survey :- it is general survey carried out visually to examine the feasibility of the project, topographical features of the area, possible sites for locating dam, submergence of land, rehabilitation problems and environmental aspects. 3

Preliminary survey :- it aims at obtaining sufficient details to establish merits and demerits of various sites , the most economical dam site, tentative cost and the benefits. 3

Final survey :- it is conducted in respect of the finally selected site to collect more precise data for detailed designs and precise estimates of the construction costs. The dam site topographical survey plan to cover an area sufficient to accommodate all possible arrangements of the dam, spillway, outlet works, and diversion works etc. 2

(b)

Spillways:- a spillway is the overflow portion in the body wall of the dam over which surplus discharge above FRL flows from the reservoir to the downstream side without 3

affecting the stability of the dam.

Spillway can be provided :-

-in the body of the dam

-at one end of the dam

Away from the body of the dam independently

4

Saturation gradient:- any earth bank against which water stands gradually gets saturated even impermeable soils are used. The water percolates through the bank from the upstream side and slopes downwards touching the downstream face. This inclined line is called the line of saturation and its slope is called saturation gradient. This saturated line is a line of demarcation between saturated soil and unsaturated soil in the dam section. The gradient is taken as 1 in 4 for all practical purposes.

Unit – V

IX. (a)

- Based on nature of source of supply

Permanent canals:- when water flows through the canals throughout the year they are known as permanent canals or perennial canals. The source of these canals is perennial rivers. These canals are closed only for repair works.

4

Inundation canals:- the canals which run only for particular periods during which water level remains above the specified level are known as inundation canals or barsati canals. Water is drawn by providing open cuts in the river bank. The flow in these canals can only be available when the water level in the river is above the bed level of the cut provided in the bank.

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4

(b)

Canal lining:- can be defined as providing an impervious layer either of concrete or asphalt to the bed and sides of the canal to control the seepage losses.

2

Advantages:-

- Water can be allowed to flow at higher velocities.
- Maintenance cost of the canal is reduced.
- The erosion of bed and sides is reduced.
- It checks growth of weeds in the canals.
- It helps to prevent canal breaches.

7

5

X. (a)

Super passage:- is similar to an aqueduct but the only difference is that the drain passes over the canal without lowering the bed of the canal. The FSL of the canal is lower than under side of the trough carrying drainage water. Thus the canal water runs

4

under gravity.

Aqueduct:- the high flood level of the drain is much below the bottom of the canal trough. The drainage water flows freely under gravity. In this case sufficient level difference is available between the canal bed and the natural drainage bed to allow sufficient height of vent way for the water way to pass flood discharge. This is the usual type of work constructed when the drain is very big in comparison to the section of the canal.

4

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(b)

Berm:- it is the horizontal distance left at ground level between top edge of the cutting and inner toe of the embankment. A best berm is one which remains at FSL or slightly above it. The width of the berm is generally fixed as 0.6m + 1/4width of combined side slopes of cutting and embankment.

3

Advantages of berms:-

- Berms protect the banks against breaches
- Berms can be used as inspection paths
- Berms provide space for future increase in width of the canal.
- Seepage losses are reduced as the silt starts covering the berms as the channel attains regime.

4

7.
