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| CSM – 12/20 |
| Agricultural Engineering |
| Paper – I |

Time : 3 hours

Full Marks : 300

The figures in the right-hand margin indicate marks.

*Candidates should attempt Q. No. 1 from
Section – A and Q. No. 5 from Section – B
which are compulsory and any **three** of
the remaining questions, selecting
at least **one** from each Section.*

SECTION – A

1. Answer any three of the following :

- (a) (i) Explain the difference between prismatic and surveyor compass. 8
- (ii) The bearings of the lines OA, OB, OC and OD are $30^{\circ} 30'$, $140^{\circ} 15'$, $220^{\circ} 45'$ and $310^{\circ} 30'$ respectively. Find the angles $\angle AOB$, $\angle BOC$ and $\angle COD$. 12

(b) (i) Explain the various methods of levelling with neat sketch. 8

(ii) The following successive readings were taken with a dumpy level along a chain line at common intervals of 20 m. The first reading was taken on a chainage 140 m. The RL of the second change point was 107.215 m. The instrument was shifted after the third and seventh readings. Calculate the RLs, of all the points. 12

3.150, 2.245, 1.125, 3.860, 2.125, 0.760, 2.235, 0.470, 1.935, 3.225 and 3.890 m.

(c) (i) Explain the classifications of open channel flow with suitable examples. 8

(ii) A stream of 135 litres per second was diverted from a canal and 100 litres per second were delivered to the field. An area of 1.6 hectares was irrigated in eight hours. The effective depth of root

zone was 1.8 m. The runoff loss in the field was 432 cu m. The depth of water penetration varied linearly from 1.8 m at the head end of the field to 1.2 m at the tail end. Available moisture holding capacity of the soil is 20 cm per metre depth of soil. Determine the water conveyance efficiency, water application efficiency, water storage efficiency and water distribution efficiency. Irrigation was started at a moisture extraction level of 50 per cent of the available moisture.

12

(d) (i) Explain soil moisture constants with suitable figures. 8

(ii) Calculate the irrigation interval for a crop of tomato with the help of the following data : 12

Field capacity = 22%

Permanent wilting point = 10%

Bulk density = 1.4 g/cc

Effective root zone depth = 60 cm

Daily water use = 0.25 cm/day

Allowable soil water depletion = 25% of available soil water.

2. (a) (i) How can the field capacity moisture content of a soil be determined ? Briefly explain the factors that influence it. 8

(ii) Find out the net quantity of irrigation water to be applied to a crop of potato with the following values of soil moisture content and other data : 12

| Depth of soil layer In cm | Field capacity Moisture content (%) | Actual Moisture content (%) | Apparent Specific gravity, g / cc |
|------------------------------|--|----------------------------------|--------------------------------------|
| 0 - 15 | 26.0 | 17.4 | 1.39 |
| 15 - 30 | 24.0 | 17.8 | 1.47 |
| 30 - 60 | 22.3 | 19.2 | 1.51 |
| 60 - 90 | 22.2 | 20.5 | 1.53 |

(b) (i) Describe most economic hydraulic sections for open channel flow with suitable sketch. 8

(ii) A rectangular notch 0.5 m wide has constant head of 400 mm. Find the discharge over the notch in liters per second, if the coefficient of discharge for the notch is 0.62. 12

(c) (i) What do you mean by hydraulic jump ?
- Write the applications of hydraulic jump.

8

(ii) Water flows over a rectangular weir 1 m wide at a depth of 150 mm and afterwards passes through a triangular right-angled weir. Taking C_d for the rectangular and triangular weir as 0.62 and 0.59 respectively, find the depth over the triangular weir. 12

3. (a) (i) Explain the working principles and components of drip irrigation system.

8

(ii) Determine the required capacity of a sprinkler system to apply water at the rate

of 1.25 cm/hr. Two 186 meters long sprinkler lines are required. Sixteen sprinklers are spaced at 12 metres intervals on each line. The spacing between lines is 18 m. 12

(b) (i) Describe the different techniques for reclamations of saline soils. 8

(ii) A drainage ditch draining 10 ha of land flows at a design capacity for three days following a storm. If the system is designed using a drainage coefficient of 2 cm, how much water will be removed during this period ? 12

(c) (i) Discuss about the following surface drain systems with line sketch : 8

(a) Bedding

(b) Parallel field drain

(c) Parallel open ditch

- (ii) Design a trapezoidal drainage canal to drain 550 hectares of land having a drainage coefficient of 2.5 cm. The soil is silt loam for which the permissible velocity is 0.6 m/s. The recommended side slope of the channel for silt loam is 1.5 horizontal to 1 vertical. It is decided to maintain a depth of flow to be equal to 1.2 m and bottom width of channel to be 0.75 m. Slope of the channel bed is 0.1%. Mannings coefficient is 0.04. Find out whether velocity of flow when carrying the drainage discharge is below the permissible velocity ?

12

4. (a) (i) Explain the different methods used to estimate discharge.

8

(ii) A pump lifts 1,00,000 litres of water per hour, against a total head of 20 m. Compute the water horse power. If the pump has an efficiency of 75 percent, what size of prime mover is required to operate the pump ? If a direct drive electric motor with an efficiency of 80% is used to operate the pump, compute the cost of electrical energy in a month of 30 days. The pump is operated for 12 hours daily for 30 days. The cost of electrical energy is 20 paise per unit.

12

(b) (i) What are the reasons for water logging ? How is categorization of water logged land done ?

8

(ii) Find out the delta (duty) of potato if the crop has a base period of 90 days. Irrigation is applied at an average interval of 10 days and at each irrigation, 5 cm depth of water is applied.

12

- (c) (i) Explain participatory irrigation management in canal command areas.

8

- (ii) Discuss about concept of mole drainage system and also suitable soil conditions for making mole drains ?

12

SECTION – B

5. Answer any three of the following :

- (a) (i) Explain the procedure to conduct pumping tests of wells.

8

- (ii) A 30 cm well fully penetrates a confined aquifer 30 m deep. After a long period of pumping, at a rate of 1200 lit/min, the draw down in the wells at 20 and 45 m from the pumping well are found to be 2.2 and 1.8 m respectively. Determine the transmissibility of the aquifer. What is the drawdown in the pumped well ?

12

(b) (i) Explain various types of erosion control measures in hilly areas. 8

(ii) Calculate the capacity of a farm pond and having the area enclosed by different contours as follows (Contour interval 1 m): 12

| S.No | Contour value (m) | Area enclosed(m ²) |
|------|--------------------|---------------------------------|
| 1 | 300 | 220 |
| 2 | 301 | 250 |
| 3 | 302 | 320 |
| 4 | 303 | 370 |
| 5 | 304 | 450 |
| 6 | 305 | 530 |
| 7 | 306 | 600 |

(c) (i) Explain various ground water recharge methods with neat sketch. 8

(ii) Following are the ordinates of direct runoff of 2.5 cm effective rainfall of 3-h

duration. Determine the ordinates of 3-

h unit hydrograph : 12

Time (h) **Ordinates of DRH**
of 2.5 cm ER

| | |
|----|-----|
| 0 | 0 |
| 3 | 35 |
| 6 | 70 |
| 9 | 120 |
| 12 | 175 |
| 15 | 185 |
| 18 | 165 |
| 21 | 150 |
| 24 | 145 |
| 27 | 110 |
| 30 | 65 |
| 33 | 25 |
| 36 | 0 |

(d) Write short notes on any four of the following : 20

(i) Role of remote sensing and GIS in watershed

(ii) Temporary gully control measures

(iii) Contour cultivation and mixed cropping

(iv) Partially penetrating wells

(v) Specific yield and specific retention

6. (a) (i) Explain surface method of ground water exploration with suitable sketch. 8

(ii) Calculate the area lost per hectare under contour bunding. The essential data are as follows : 12

Land Slope = 5%

Base width of bund = 1.25 m

Horizontal interval = 25 m

The side and lateral bunds are also in the field

(b) (i) List out the various structures used in a subsurface drainage system and state their uses. 8

(ii) Calculate the spacing and length of contour bund for a medium rainfall area on 4 ha, if land of area has 5% slope.

12

(c) (i) Describe the land capability classification. Explain its various components, conservation measures, suitability and limitations of each classes and sub-classes. 8

(ii) Calculate the soil erodibility factor (K) for use in universal soil loss equation, using the following information : 12

(1) Rainfall intensity ; 5 cm/hr

(2) Maximum 30 minutes rainfall intensity of the storm : 0.5 cm/hr

(3) Observed soil loss : 4.5 tonnes/ha

(4) LS factor = 1 (Assume depth of rainfall to be 3 cm)

7. (a) Explain the basic concept of watershed development. What are objectives of watershed development ? 12
- (b) What are different phases of planning of watershed management activities ? 12
- (c) What do you understand by integrated watershed development ? Explain in detail. 12
- (d) Explain the universal soil loss equation. 12
- (e) Explain the ground water recharge estimation methods. 12
8. (a) Explain, in detail, about foundation in block cotton soil. 12
- (b) Explain the fundamental requirements of a poultry house. 12

- (c) A brick pier $600 \text{ mm} \times 600 \text{ mm}$ is 4 m high. It has to carry an axial load of 520 kN . The allowable bearing capacity of the soil on which the pier is to rest is 250 kN/m^2 . The weight of brick masonry is 18.84 kN/m^3 . The angle of repose is 30° and the weight of earth is 16 kN/m^3 . Design the suitable foundation for the pier. 12
- (d) Explain king post and queen post truss with suitable sketch. 12
- (e) What is slump test ? Explain it with suitable figures. 12

