

CSM -- 12/18
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 three of the remaining questions, selecting at least one from each Section.

SECTION – A

1. Answer any three of the following :

(a) (i) Differentiate between Plane and Geodetic surveying. 8

(ii) The following observations refer to reciprocal level taken with one leveling instrument :

P and Q are the two points of the two banks of a river. The staff readings on P and Q were observed to be 1.82 m and 2.74m respectively when the instrument

was placed near to the point P; 0.92m and 1.60m when the instrument placed near to the point Q. The true R. I. of point P is 126.38. Find the true difference in elevation between points P and Q and the true elevation of Q. 12

(b) (i) Define soil water. Describe the different forms of soil water. 8

(ii) A single acting reciprocating pump is lifting water at the rate of 2.5m^3 per minute to a storage tank at a height of 20m from the sump. The pump has a bore of 30 cm and a stroke of 40cm. Find the slip, coefficient of discharge and horse power required to operate the pump if the diameter of suction pipe is 10cm and the pump runs at 80 rpm. Assume an overall efficiency of 80 percent. 12

(c) (i) Explain the concept of Bio-drainage. 8

(ii) Determine the hydraulic conductivity of a soil at 10°C whose intrinsic permeability is 4.0×10^{-6} sq. cm. The

dynamic viscosity and temperature relationship can be followed as :

Dynamic viscosity, μ (Poise) =

$$\frac{0.0179}{(1 + 0.03368t + 0.000221t^2)}; \text{ in which}$$

't' is the temperature in °C. 12

(d) (i) Define Culvert. Enumerate the difference between pipe culvert and box culvert. 8

(ii) A 2 ha area wheat crop is irrigated by an outlet of canal system with an outflow rate of 50 litres per second at the field head. Net depth of water application is 4.5cm. The consumptive use rate of the crop is 2.2mm per day. Assuming field efficiency 80 percent, determine the irrigation efficiency and irrigation period. 12

2. (a) (i) Define specific energy in a channel section. With the concept of specific energy, derive the criterion of critical state condition of a channel section on zero slope and velocity distribution coefficient is 1.0. Also show that at critical state of flow, the specific energy head in a rectangular channel laid on a

- level ground equal to 1.5 times the depth of flow. Assume velocity distribution coefficient is 1.0. 10
- (ii) A canal will be constructed with a bed width of 10.0m, full supply depth is 1.6m. Side slope in cutting is 1 : 1 (V : H) and refilling is 1.5 : 1(V : H). Top width of banks is 1.6m. Free board of 0.8m is to be provided above the supply depth. Calculate the balancing depth so as to get the most economical section. 10
- (b) (i) Define hydraulic jump. How it is applicable in irrigation works ? 8
- (ii) A stream function is given by $\psi = 5x^2 - y^2$. Determine the magnitude of velocity components at the point(2, 1). 12
- (c) (i) Do you think that the socio-economic development of an area depends on the development of agriculture ? Write Yes or No ? Justify it. 10
- (ii) A farmer has 1 ha of land made into 5 borders of sizes 100m × 20m each. He applied water to this land when root zone

depth is 95cm. After 48 hours of irrigation when soil achieved its field capacity, he takes a soil auger to the borders and by boring holes in to soil, he observed the wetted soil depths. at five different places were 75, 80, 97, 100 and 95 cm respectively. Determine the water distribution efficiency and storage efficiency. 10

3. (a) (i) Define reference crop evaporation. Describe its importance in scheduling of irrigation. 10

(ii) Compute the drainage coefficient for design of open ditch system as surface drainage means for draining 1500 ha watershed area with the following informations: 10

Runoff entering the watershed @ 4.5m^3 per second for 3 hours period.

Total rainfall during 24 hours duration is 8.5cm

Infiltration loss during 24 hours duration is 1.5cm

Crop water tolerance depth is 8.0cm

(b) (i) Show that, the most economical trapezoidal channel section is obtained when half of top width is equal to one of the sloping side. 8

(ii) The area within the contour line at the site of reservoir and the face of the dam are as follows :

Contour	Area(m ²)	Contour	Area(m ²)
100	20000	104	200500
101	35000	105	510000
102	56000	106	72000
103	101000		

Take 100 as the bottom level of the reservoir and 106 as the top level of the weir, calculate the capacity of the reservoir. 12

(c) (i) Describe the low cost micro-irrigation techniques. 8

(ii) A large tank having a circular orifice 6.45sq.cm. in area in its vertical sides rests on a smooth horizontal surface.

When the depth of water in the tank is 1.50metre, the discharge through the orifice is 125kg per mintute. Determine the coefficient of discharge of the orifice. 12

4. (a) (i) Describe the different systems employed under relief drains. 8
- (ii) The rise of water in an inverted pitot tube fitted in a pipe of 10cm diameter showed 3.1m and 0.8m above the water surface. Determine the flow rate in the pipe. 12
- (b) (i) Explain the working of hydrants used in underground pipeline irrigation system. 8
- (ii) A centrifugal pump lifts 1500 litres per mintute against a total head of 15metres. Compute the water horse power. What size prime mover is required to operate the pump if the pump has an efficiency of 75 percent ? If a direct drive electric motor having an efficiency of 82 percent is used to operate the pump. Compute the cost of electrical energy in a year. The pump is operated 8 hours daily for 240 days in a year. The cost of electrical energy is Rs. 3.10 per unit. 12

- (c) (i) Define hydraulic jump. How it is applicable in irrigation works ? 8
- (ii) A survey line ABC crosses a river, B and C being the near and farthest banks respectively. Standing at D, a point 50m measured perpendicularly to AB at B, the bearings of A and C are S 50° W and N 40° W respectively. The distance of AB being 30m, find the width of the river. 12

SECTION - B

5. Answer any three of the following :

- (a) (i) Define "Transmissibility" and "Storage Coefficient" of an aquifer. 5
- (ii) In an alluvial basin of 100km^2 , 85Mm^3 of groundwater was pumped in a year and the groundwater table dropped by about 5m during the year. Assuming no replenishment, estimate the specific yield of the aquifer. If the specific retention is 14%, what is the porosity of the soil ? 10
- (iii) How will you select a site for a rain gauge station ? 5

- (b) (i) Give the steps involved in designing a threshing floor. Give the site conditions for locating a drying floor. 10
- (ii) Differentiate between drop spillway and drop inlet pipe spillway. Under what conditions they are recommended? 10
- (c) (i) The watershed or catchment of a river system is an ideal unit for phased agricultural development. Discuss. 10
- (ii) The mean monthly flows (cumec) in a river during 2007 is given below :

Month	Flow
Jan	60
Feb	45
Mar	35
Apr	25
May	15
June	22
July	50
Aug	80

Month	Flow
Sept.	105
Oct	90
Nov	80
Dec	70

Calculate the minimum storage required to maintain a demand rate of 40 cumec. 10

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

- (i) Factors affecting runoff
- (ii) Mulching
- (iii) Priority watershed
- (iv) Chute spillway
- (v) Farm fencing

6. (a) Compute the erosion index (EI 30) value for the data given below: 20

Starting time Shifting time Reading at the starting Reading at the shifting

Hr	min	Hr	min	mm	mm
16	00	16	05	0.0	9.5
16	05	16	15	9.5	18.5
16	15	16	22	18.5	27.5
16	22	16	30	27.5	36.5
16	30	16	50	36.5	39.5
16	50	17	20	39.5	41.4

- (b) Write on the characteristics of the raindrops that are important from soil erosion point of view. 10
- (c) Calculate the discharge from a tube well of 30cm diameter penetrating fully into a confined aquifer of 30m thick and having a permeability of 40m/day. The drawdown in the well is 3 m and zero drawdown at 300m from the well. If the diameter of the well is doubled, find the percentage increase in the yield, the other conditions remaining the same. 20
- (d) Explain briefly the evaporation process. What are the factors that influence the process of evaporation ? 10

7. (a) A contour bund is to be constructed on a land with 2.5% slope. The vertical interval is 1.5m and the area receives maximum rainfall of 10cm for a 10 year recurrence period. One fourth of the rainfall is lost as surface runoff. The bund side slope is 1.5 : 1; a free board of 10% of bund height is to be provided. Design the bund size and also determine the

- percentage area lost due to bunds. Assume the slope of the seepage line to be 4 :1. 30
- (b) Explain the principle of Coshocton Wheel Sampler with a neat sketch and derive the relationship for sampler ratio. 20
- (c) Write a detailed note on cage housing for poultry birds. 10
8. (a) Enumerate the conditions under which permanent gully control structures are recommended. Illustrate your answer with suitable examples and proper diagrams. 20
- (b) Describe the manufacture of ordinary Portland cement by wet process, Also, draw the flow diagram. 20
- (c) Explain the process of sea water intrusion with a neat sketch and give the equation connected to it. Also, discuss the methods for controlling sea water intrusion. 10
- (d) Explain the procedures for designing a silo. 10

