CSM – 12/19

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) Why chain surveying is also called chain triangulation ? Explain with example and line diagram. 8

   (ii) Following are the bearings taken in a closed compass traverse : 12

   Compute the interior angles and correct them for observational errors.

Line	F. B.	B. B.
AB	S37°30′E	N37°30′W
BC	S43°15′W	N44°15′E
CD	N73°00′W	S72°15′E
DE	N12°45′E	S13°15′W
EA	N60°00′E	S59°00′W

(b) (i) Explain the five important rules (methods) for the calculation of farm area with boundaries. 8

(ii) Reduce the set of differential levelling notes in the table below and perform the arithmetic check. 12

Station	BS	IS	FS	Elevation
BM-100	2.71			483.61
TP-1	3.62		4.88	
TP-2	2.51		3.92	
TP-3	3.17		2.81	
TP-4	1.47		1.62	
BM-101			1.21	

(c) (i) By giving suitable example, differentiate : Uniform and Non-uniform flow, Steady and Unsteady flow, Laminar and Turbulent flow. 8

(ii) The soil moisture content in root zone, prior to irrigation are as : 12

Depth of sampling, cm	Wt. of moist soil sample, gm	Oven dry wt. of soil sample, gm	Other Data
0 – 25	134.60	126.82	The B.D. in
25 – 50	136.28	127.95	root zone
50 – 75	122.95	115.32	= 1.5 g/cc,
75 – 100	110.92	102.64	AMHC of soil = 17.8 cm/m depth

Determine moisture content in root-zone and net depth of irrigation.

(d) (i) Define and differentiate Reynold's No. and Froude No. quoting suitable examples along with its significance in fluid flow. 8

(ii) The Topographic survey of a field gave the following elevations (in meters) at grid points : 12

	1	2	3	4	5
A	10.65	10.43	10.07	9.68	9.67
B	10.47	10.42	9.95	9.84	9.75
C	10.32	10.08	9.92	9.65	9.48
D	9.89	9.48	9.67	9.41	9.132

Calculate the elevation of the centroid of the field. Stakes are to be put to guide the leveling of the field into a playground. Calculate the cut or fill at the grid points. Compare quantities of earth work in cut and fill.

2. (a) (i) Explain with line sketch critical depth and hydraulic jump. Write its uses. 8

(ii) A rectangular horizontal channel 2 m wide carries a flow of 4 m^3/s. The depth of water on the d/s side of the hydraulic jump is 1 m. 12

(A) What is the depth u/s ?

(B) What is the loss of head ?

(b) (i) Explain best hydraulic sections, schematically, for open channel flow. 8

(ii) What are the most efficient dimensions (the best hydraulic section) for a concrete (n = 0.012) rectangular channel to carry 3.5 m^3/s at $S_o = 0.0006$? 12

(c) (i) What are irrigation indices ? Explain its role in scheduling irrigation. 8

(ii) A stream of 135 ℓps was diverted from canal and 100 ℓps was delivered to the field. An area of 1.6 ha was irrigated in 8 hours. The effective depth of root zone was 1.8 m. The runoff loss in the field was 432 m^3. 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. AWHC of 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% of the available moisture. 12

3. (a) (i) Explain merits and demerits of various types of micro irrigation system. 8

(ii) Determine the required capacity of a sprinkler system to apply water @12.5 cm/hr. Two 186 m long sprinkler lines are required. 16 number of sprinklers are spaced at 12 m intervals on each line. The spacing between lines is 18 m.

Allowing 1 hr for moving each 186 m sprinkler line, how many hours would be required to apply 5 cm irrigation to a square 16 ha field ? How many days are required ? (10 hours/day) 12

(b) (i) Discuss the possible strategies for salinity control and drainage effluent utilization, with particular reference to high rainfall coastal areas. 8

(ii) Assume a drainage channel on a grade of 0.1%, depth of water 40 cm, bottom width 60 cm and side slopes 1.5 : 1. Calculate the velocity of flow and carrying capacity of drainage channel. (Assume n = 0.025) 12

(c) (i) Explain the various methods of irrigation water measurement. 8

(ii) Determine the discharge capacity of an underground concrete pipeline from the given data ; (Assume value of f = 0.009), Diameter of the pipe : 15 cm, length of the pipeline : 150 m, difference in elevation between water levels at pump stand and discharge point : 2 m. 12

4. (a) (i) Where, why and how the interceptor drains is laid out ? Give schematic diagram to depict its installation. 8

(ii) Design an open ditch to drain 550 ha of land having a drainage coefficient of 2.5 cm. Soil is silt loam and slope of channel bed is 0.1%. 12

(b) (i) Differentiate irrigation and drainage. Justify how drainage is equally important in the monsoon based climate of the country ? 8

(ii) Undisturbed soil sample was collected from a field two days after irrigation, when the soil moisture was near field capacity. The inside dimensions of core sampler were 7.5 cm diameter and 15 cm deep. Weight of the core sampling cylinder with moist soil was 2.76 kg and the weight with oven-dried soil was 2.61 kg. The weight of the core sampling cylinder was 1.56 kg. Determine the water depth in cm per meter depth of soil. 12

(c) (i) Explain participatory irrigation management in canal command areas. 8

(ii) In a sub-surface drainage system, the laterals are laid out 50 m apart and 200 m long and have a grade of 0.3% (1) If the drainage coefficient of the area is 2 cm, what size tiles have to be used ? (2) If the drainage coefficient is increased to 3 cm, what will be the spacing of laterals ? Assume the value of n = 0.0108. 12

SECTION – B

5. Answer any **three** of the following :

(a) (i) Explain the procedure to conduct pumping tests of wells. 8

(ii) A well in a confined aquifer is pumped at a constant rate of 1200 ℓpm. After 600 minutes of continuous pumping the drawdown in piezometers used for pumping tests were measured. The results are as follows : 12

Distance of piezometer from center of well (m)	Drawdown (m)
2	7.25
10	4.75
50	2.50
100	1.50
200	0.50
2	7.25

Following Thiem method, the values of s and r are plotted on a single log paper. The slope of the best fit straight line drawn through the plotted points is measured to be equal to a drawdown difference of 3.25 m per log cycle of r(s).

(1) Calculate the aquifer transmissibility, assuming steady state drawdown.

(2) Calculate the transmissibility values of different sections and average transmissibility using the Thiem procedure.

(b) (i) Differentiate the farm pond and percolation pond. How do you design farm pond ? Discuss the design and construction of plastic lined pond. 8

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

Contour value (m)	Area enclosed (m^2)
250	220
251	290
252	340
253	370
254	480
255	550
256	620

(c) (i) Explain the different methods of ground water recharge and also describe artificial recharge. 8

(ii) Derive the ordinates of 3-h unit hydrograph for a watershed. The measured discharge rates at the outlet of watershed is given below. The area of watershed is 500 km^2. 12

Time, hr	Discharge, m^3/Sec
– 3	10
0	10
3	10
6	37
9	50
12	75
15	115
18	110
21	101
24	79
27	65
30	61
33	57
36	50

Time, hr	Discharge, m^3/Sec
39	47
42	45
45	40
48	33
51	30
54	25
57	17
60	15
63	10
66	10

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

(i) Role of remote sensing and GIS in watershed

(ii) Vegetative control measures

(iii) Mixed cropping and inter cropping

(iv) Multiple well system

(v) Strorage structure for fertilizers and seeds

6. (a) (i) Write the procedure for development and testing of wells. 8

(ii) On a 20% hill slope, it is proposed to construct bench terraces. If the vertical interval is 2 m. Calculate ; (1) length per ha, (2) amount of earth work and (3) area lost, both for vertical cut and batter slope of 1 : 1. The cut should be equal to fill. 12

(b) (i) Compare the mechanical measures and vegetative (biological measures) for control of erosion with regard to cost effectiveness, availability, local skill involved and ease of installation. 8

(ii) Design a grassed waterway of parabolic shape to carry a flow (2.6 m^3/sec), down a slope of 3%. The waterway has a good stand of grass and a velocity of 1.75 m/sec can be allowed. (Assume "n" = 0.0040). 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) How do you carry out the demarcation of priority watershed ? 12

(b) What do you understand by integrated watershed development ? Explain in detail. 12

(c) Explain site selection, design and construction of contour ditches. 12

(d) Enumerate different types of strip cropping with neat schematic diagram. 12

(e) Illustrate the significance of hydrologic cycle in alleviation of drought and submergence from agricultural land. 12

8. (a) Explain, in detail, the planning and layout of farmstead. Sketch out its various components. 12

(b) Design a small poultry house for 15 birds. Draw the floor plan, cost estimate and enlist the required poultry equipments. 12

(c) Explain the preparation of different types of concrete. What is slump test ? Explain it. 12

(d) Work out the design, construction and layout of threshing floor and drying floor for small farm of 2 ha size. 12

(e) Compare the improved and traditional grain storage structures based on various performance parameters, cost and construction techniques, enlisting five examples of each. 12