CSM – 12/21

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** questions of the following :

   (a) (i) Define benchmark and reduced level ? What are the different kinds of bench-marks ? 8

   (ii) If, Reduced level of Benchmark A = 50,000 m. 12

Reading on staff held at A = 2.435 m

Reading on staff held at station point B = 1.650 m

Calculate :

(A) Height of collimation

(B) Reduced level of station point B

(C) Rise/fall of B with respect to A

(b) (i) Write the different types of levels and list the essential parts of a Level. 8

(ii) What do you mean by whole circle bearing and reduced bearing ? Convert the whole circle bearing into reduced bearing : 50°, 176°, 210°, 232°, 150°, 76°, 310°, 242°. 12

(c) (i) Differentiate between Prismatic compass and Surveyor's compass with reference to reading and tripod. If, the fore bearing of a line PQ is N 28°W. What is its back bearing ? 8

(ii) Discuss about the levelling layout of field for irrigation and drainage systems. 12

(d) (i) A trapezoidal bund of 80 m long is to be constructed having bottom width as 4 m and top width as 2 m. The height of one end of bund is 1.2 m and that of the other end is 1.5 m. Determine the volume of earth fill for making bund. 8

(ii) Design an irrigation channel in alluvial soil using Kennedy's theory. The following data are given. $Q = 15\ m^3/s$. Chezy's C = 43, Bed slope as decided by local condition is 1 in 4000. Critical velocity ratio $V/V_c = 1$, Kennedy's C for the soil = 0.55. Check the velocity with Chezy's equation. 12

2. (a) (i) Write short notes on the following : 8

A. Hydraulic Jump

B. Critical Depth

C. Prismatic Channel

D. Alternate depths

(ii) Define the open channel flow. Write the problem associated with open channel flow. Classify the open channel flow. 12

(b) (i) A trapezoidal earthen channel is constructed with a bed slope of 1 in 3500. The bottom width is 2 m, depth of flow is 80 cm and the side slope is 2 : 1. Calculate the velocity of flow and discharge by Chezy's and Manning's formula. Assume Chezy's C = 43 and Manning's n = 0.023. 8

(ii) What do you mean by lining of channels ? Discuss about the materials used for lining of channel. 12

(c) (i) Explain the Furrow Method of Irrigation and write the advantages of furrow irrigation. 8

(ii) Design a check basin system for a plot size of 4000 m^2 (80 m × 50 m) to irrigate wheat crop. Field capacity of the soil is 20% and permanent wilting point is 10%. Crop is irrigated after 40% of the available moisture is depleted. Effective root zone depth is 100 cm, apparent sp. gravity of soil is 1.50. A discharge of

8 lps is used to irrigate the plot. The characteristics constants (a, b) for infiltration are 0.8 and 0.5 respectively. The soil is loamy sand soil and the field is almost level. 12

3. (a) (i) Classify the Irrigation methods and explain factors affecting the choice of a particular method. 8

(ii) A discharge of 20 lps is supplied to a border strip 100 m long and 6 m wide. The uniform rate of infiltration is 0.25 cm/min and depth of flow over the surface can be assumed as constant of 5 cm. Find : 12

(A) The underground distribution of water

(B) The time to reach the water at the end of the run.

If this stream size is not sufficient to irrigate the whole border, find out the minimum stream size.

(b) (i) Explain the check basin method of Irrigation and write adaptability of check basin method. 8

(ii) Write the Advantages and adaptability of sprinkler irrigation system. Also discuss about the disadvantages and limitations of sprinkler irrigation system. 12

(c) (i) A lateral has 12 sprinklers spaced 14 m apart. The laterals are spaced 20 m on the main line. Determine the amount of fertilizer to be applied at each setting when the recommended fertilizer dose is 80 kg/ha. And what is uniformity coefficient ? 8

(ii) Determine the uniformity coefficient from the following data obtained from a field test on a square plot irrigated by four sprinklers. 12

Sprinkler : 4.365 × 2.381 mm nozzles, pressure : 2.8 kg/cm^2, spacing : 24 m × 24 m, wind : 3.5 km/hr from

South – West, relative humidity : 42%, time of test : one hour.

S = Location of sprinkler, others are application depth, in mm.

S	8.9	7.6	6.6	**S**
8.1	7.6	9.9	10.2	8.3
8.9	9.1	9.1	9.4	8.9
9.4	7.9	9.1	9.4	9.1
S	7.9	6.6	6.8	**S**

4. (a) (i) Write advantages and limitations of drip irrigation system. 8

(ii) Design the drip irrigation system. The following data are given : 12

Crop : banana, spacing : 1.5 × 1.35 m, area : 1 ha (100 m × 100 m), Slope : 0.4 %, water source : well, static head : 10 m, peak pan evaporation rate : 12 mm/day, soil : clay, clay content : 60%, Field capacity : 48%, wilting point : 25%, bulk density : 1.3 g/cc, Effective root zone depth : 60 cm and wetted area : 60%.

(b) (i) Describe the types of drip irrigation system. 8

(ii) Analysis of 10 gm soil sample showed that the total cocentration of exchangeable cations was 2.50 meq and that of exchangeable sodium was 0.8 meq. Express the cation exchange capacity in meq / 100 gm soil and exchangeable sodium in per cent. 12

(c) (i) What is drainage ? What is the necessity of drainage of agricultural land ? 8

(ii) Define the Drainage Coefficient. Enlist the factors on whcih is value depends. A watershed of 1500 hectares is discharging through a drain at an average ratio of 2.5 m^3/s. If the drainage coefficient is 3 cm, what would be the discharge through the drain ? 12

SECTION – B

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

(a) (i) How important is groundwater ? Explain it. 8

(ii) What is the role of groundwater (GW) in hydrologic cycle ? Provide the water balance equation and highlight the groundwater related components in it. Enumerate the major reasons for GW level fluctuations. 12

(b) (i) What are the functions of Wells ? 8

(ii) Describe the different types of Water Wells. 12

(c) (i) Enlist the disadvantages and disadvantages of Tubewells. 8

(ii) What is hydraulic ram and what are the criteria for Site Selection of hydraulic ram Installation. Write the advantages of hydraulic ram. 12

(d) (i) What is Well Interference ? Write salient applications of Well Interference. 8

(ii) Write the suitable condition for selection and main component of Propeller Pumps. What are the steps should be followed for installation and operation of a propeller pump. 12

6. (a) (i) Differentiate between geological erosion and accelerated erosion. Discuss their role in soil formation and erosion. 8

(ii) Calculate the amount of soil eroded by splashing from a plot of 60 m × 100 m size. The details are given : 12

$\gamma = 1.5$ t/m^3, $i = 2.8$ mm/min, $V_c = 5.49$ m/s, $t = 30$ min, $d_k = 3.5$ mm, $d_{dk} = 0.2$ mm, $\sin \alpha = 0.1$.

(b) (i) What are the different types of water erosion ? Describe them briefly. 8

(ii) Discuss the factors that effect water erosion. 12

(c) (i) Calculate the terminal velocity of a raindrop of 0.8 mm diameter at standard atmospheric pressure and air temperature of 20°C. Take air density as 1.2 kg/m^3. 8

(ii) Describe the mechanics of water erosion. 12

7. (a) Discuss the different Vegetative methods of Control of runoff in a Gully stabilization programme. 12

(b) Explain the temporary gully control structure. And under what situation they should be preferred ? 12

(c) State the situation under which permanent gully control structure should be built and what are the functions they are required to perform ? 12

(d) A raindrop of 2 mm diameter falls vertically and there is no wind velocity. Calculate the net downward force due to the fall of the raindrop. If an air current moves vertically upward with a speed of 5.5 m/s, what will be the net downward force ? Also determine whether the drop will rise or fall ? 12

(e) Determine the terminal velocity and K. E. of 2 mm and 4 mm diameter raindrops. Given that : 12

(i) Drag coefficient C_d = 0.517 for 2 mm and 0.559 for 4 mm drops.

(ii) Density of water at 20°C, $\rho_w = 998\ kg/m^3$, density of air at 101.3 kpa $\rho_a = 1.20\ kg/m^3$.

8. (a) Give an outline of the : 12

(i) Hydrologic

(ii) Hydraulic

(iii) Structural design of the permanent gully control structures

(b) What is watershed ? Explain the aim of watershed management programme. 12

(c) State the advantages and limitation of drop spillway. Briefly explain the components of drop spillway. 12

(d) Discuss the Improved Storage Structures and Modern Storage Structures for grain. 12

(e) Discuss the different types of storage structure for semi perishable commodity. 12