

CS-80/06
AGRICULTURAL ENGINEERING
Paper-I

Time : 3 Hours]

[Full Marks : 300

- Note :** (1) Candidates should attempt Question No. 1 from Section-A and Question No. 5 from Section-B which are compulsory, and any **three** of the remaining questions, selecting at least one from each Section.
- (2) All questions carry equal marks.

SECTION – A

1. Answer any **three** of the following out of (a), (b), (c) and (d) :

- (a) (i) Differentiate between a Gunter's chain and an Engineer's chain. State relative advantages of each. 8
- (ii) In levelling between two points A and B on opposite banks of a river, the level was set up near A, and the staff readings on A and B were 1.285 and 2.860 m respectively. The level was then moved and set up near B and the respective readings on A and B were 0.860 and 2.220. Find the true difference of level between A and B. 12
- (b) (i) A pump with 15 cm suction pipe and 12 cm delivery pipe has an efficiency of 80% and is driven by a 11 kW (15 m.h.p. motor). A differential monometer connected to suction and delivery sides shows a maximum pressure head of 9.15 m of water. Predict the discharge of water through the pump. 10
- (ii) When an agricultural land is said to be waterlogged ? Discuss the harmful effects of waterlogging and the various antiwaterlogging measures. 10
- (c) (i) How do you arrive at a correct depth of irrigation to be applied to a crop at a particular time ? 8
- (ii) Winter maize is grown in a sandy loam soil having infiltration rate of 50 mm/hr. The field capacity and wilting point of the soil are 22% and 11% respectively. Crop is irrigated after 50% of the available moisture is depleted. The furrow is constructed along a slope of 0.1%. Apparent specific gravity of the soil is 1.55. Design the furrow irrigation system. 12
- (d) (i) Show that for a given discharge Q , specific energy is minimum when Q^2T/gA^3 is unity. Here T is the water surface width. Obtain expressions for the critical depth and minimum specific energy for a rectangular channel of area A . 10
- (ii) Show that a trapezoidal channel with given area and side slopes $Z:1$ is most efficient when hydraulic radius is half the depth of flow. 10

2. (a) (i) In a tile drainage system the drains are laid with their centres 1.5 metres below ground level. The impervious layer is 9.0 metres below the ground level and the average annual rainfall in the area is 80 cm. If 1% of the annual rainfall is to be drained in 24 hours to keep the highest position of the watertable to 1 metre below ground level, determine the spacing of the drainpipes. Coefficient of permeability may be taken as .001 cm/sec. 10
- (ii) If 100 sample cans are uniformly spaced in the area covered by four sprinklers and the average depth of water caught in a given time is 1.25 cm with the average variation from the mean 0.2 cm, what is the uniformity coefficient ? Assuming that the infiltration rate was not exceeded and the water did not penetrate below the root zone, what is the application efficiency ? 10
- (b) (i) Why is the reciprocating pump called a positive displacement pump ? Explain the essential parts and working principle of the pump. 10
- (ii) Design the most economical trapezoidal section of channel to carry a discharge of $10 \text{ m}^3/\text{s}$ in a bed slope of 1 in 3000. For stability the side slope is 1.5 : 1 and the value of Manning's n is 0.025. 10
- (c) (i) What are the benefits of subsurface drainage ? Under what situation subsurface drainage is preferred over the surface drainage system ? 10
- (ii) In a subsurface drainage system, the drains are located at spacing of 30 m and the drainage line is 300 m long with a slope of 0.25%. What size of tiles will be required if the drainage coefficient is 3 cm ? 10
3. (a) (i) What are the advantages and limitations for conveyance of irrigation water through pipeline ? What parameters should be included in the design of a pipeline conveyance system ? 10
- (ii) Discuss the adaptability and advantages of the drip irrigation system. What are the different components of the system ? 10
- (b) (i) Describe the advantages and limitations of a sprinkler method of irrigation. What are the different types of sprinklers used in the field ? 10
- (ii) The root zone depth of a particular crop is 1.20 m. The soil moisture percentages at field capacity and at permanent wilting point are 25 and 8 respectively. The relative density of the soil is 2.65 and the porosity is 40% At a time when the soil moisture is 15%, a farmer applies 300 mm of water depth. What percentage of this applied water will go as a waste ? 10
- (c) (i) What is local attraction ? How is it detected and eliminated ? 8
- (ii) In an old survey made when the declination was 4° W , the magnetic bearing of a given line was 210° . The declination in the same locality is now 10° E , what are the true and present magnetic bearings of the line ? 12

4. (a) (i) What are the differences between infiltration, percolation and seepage ? How is the hydraulic conductivity defined ? 10
- (ii) A Control sluice spanning the entry of a 4.0 m wide rectangular channel having a mild slope admits water at the velocity of 16.0 m/s. Find whether a hydraulic jump is expected in the channel downstream from the sluice. 10
- (b) (i) Describe the different components and working of a parshall flume. What are its relative advantages and disadvantages ? 10
- (ii) A rectangular orifice has a length of 15 cm. The depths of water on the upstream and downstream sides are 20 cm and 10 cm respectively above the bottom of the orifice. Calculate the discharge through the orifice. 10
- (c) (i) Describe various methods of contouring. Discuss the merits and demerits of each. 10
- (ii) Sketch the streamlines represented by $\Psi = x^2 + y^2$ and $\Psi = x^2 - y^2$ showing the direction of flow in each case. Also find out the velocity and its direction at (1,1). 10

SECTION – B

5. Answer any **three** sub-parts not exceeding **200** words for each sub part:
- (a) (i) Explain the importance of land use capability classification. 6
- (ii) How capacity of a pond can be determined ? Calculate the capacity of a pond if area enclosed by different contours are as follows : 8
- | Sl.No. | Contour value (m) | Area enclosed (m ²) |
|--------|-------------------|---------------------------------|
| 1 | 245 | 275 |
| 2 | 246 | 298 |
| 3 | 247 | 325 |
| 4 | 248 | 356 |
| 5 | 249 | 383 |
| 6 | 250 | 417 |
- (iii) What is the function of a grassed waterway ? Briefly explain its design procedure. 6
- (b) (i) Explain properties and constituents of cement. Classify cement and make brief comments on them. 10
- (ii) What are the different types of dairy barns? List the components of a standard dairy barn. 5
- (iii) Write a very brief note on deep litter poultry house. 5
- (c) (i) Discuss the necessity of gravel packing in a tube well. 10
- (ii) Explain reverse rotary drilling method of tube well construction. 10

- (d) (i) Discuss briefly about universal soil loss equation. 10
- (ii) Explain any one of the models for the process of infiltration. Find infiltration rate in cm/h through a soil after 1 hour 30 minutes if cumulative infiltration in cm is expressed as $I = 0.02 t^{0.77}$, where t is time elapsed in seconds. 10
6. (i) Write briefly on the characteristics of cement concrete and reinforced cement concrete. 20
- (ii) What is bearing capacity of a soil ? Determine the width of the foundation of a building wall 4m high, 450 mm wide and 15m long. Bearing capacity of the soil is 5000 kg/m^3 and unit weight of masonry is 2800 kg/m^3 . 10
- (iii) What is a silo ? Differentiate between a pit and a trench silo. Design a trench silo for a small farm house having the following herd. The silage is fed 150 days in a year. 30
- | Animal | Body wt. Per animal (kg) | No. of animal | Rate of feeding per 100 kg of body wt. (kg) |
|---------|--------------------------|---------------|---|
| Cow | 400 | 70 | 3.0 |
| Bullock | 510 | 20 | 3.6 |
| Buffalo | 650 | 50 | 4.2 |
7. (i) What is a terrace? Classify them. Explain bench terrace. 20
- (ii) Bench terrace is to be constructed in a hilly area with 12 % slope. Considering a vertical interval of 2.0 m and a batter slope of 1 : 1. Calculate : 20
- (a) width of terrace
- (b) length of bench terrace per hectare
- (c) earth work requirement
- (d) area lost in percentage
- (iii) List types of agronomical practices for controlling soil erosion. Explain strip cropping in detail. 20
8. (i) What is runoff ? Classify runoff. Explain Rational formula for estimation of peak rate of runoff from a catchment. What are its limitations ? 20
- (ii) Discuss briefly on the factors of runoff from a catchment and their effect on the hydrograph. 20
- (iii) Calculate discharge of a tubewell extracting water from an unconfined aquifer if hydraulic conductivity and radius of influence are 2.1 m/h and 300 m respectively. R.L. of ground surface, water table, pumping water level and the impervious layer are 75m, 30m, 21m and 12m respectively. 20