AGRICULTURAL ENGINEERING
Paper – I

Time Allowed : **Three** Hours	Maximum Marks : **200**

Question Paper Specific Instructions

Please read each of the following instructions carefully before attempting questions :

There are **EIGHT** questions in all, out of which **FIVE** are to be attempted.

Questions no. **1** and **5** are **compulsory**. Out of the remaining **SIX** questions, **THREE** are to be attempted selecting at least **ONE** question from each of the two Sections A and B.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.

All questions carry equal marks. The number of marks carried by a question/part is indicated against it.

Answers must be written in **ENGLISH** only.

Unless otherwise mentioned, symbols and notations have their usual standard meanings. Assume suitable data, if necessary and indicate the same clearly.

Neat sketches may be drawn, wherever required.

SECTION A

Q1. **Answer the following :** $8 \times 5 = 40$

(a) Discuss the issues and challenges related to watershed management. What is the role of peoples' participation in watershed development ? 8

(b) Discuss land shaping concepts, purpose and applicability in a watershed. 8

(c) Explain in brief, different methods of calculating earth and soil volumes. 8

(d) Explain the procedure to conduct a topographical survey of a watershed by direct contour method. 8

(e) Describe briefly, the SCS-CN method of runoff estimation. A watershed has 100 ha area. The watershed has 20 ha pasture in silty clay soil of 2% slope (CN = 65), 30 ha of pasture on silty loam soil of 0·5% slope (CN = 70) and remaining 50 ha of wheat crop on loam soil of 1% slope (CN = 85). Estimate the weighted curve number for the watershed. 8

Q2. (a) What are rainfall Depth-Area-Duration (DAD) curves ? Write down the step-by-step procedure for drawing Depth-Area-Duration curves. 10

(b) Explain in brief, different types of erosion and their causes. 10

(c) Define Water Harvesting. Write the components and sequential steps for runoff water harvesting systems in the dry regions of India with suitable sketches. Also write the limitations of water harvesting systems. 10

(d) Design a waste weir using the following data : 10
   Cumulative catchment area : 35 ha
   Flood depth over the crest of weir : 0·6 m
   Intensity of rainfall : 50 mm/hr
   Runoff coefficient : 0·5

Q3. (a) Write the step-by-step procedure for planning and design of a graded bunding. 10

(b) Design a grassed waterway of parabolic shape to carry a flow of 2·6 m³/s, down a slope of 3%. The waterway has a good stand of grass and velocity of 1·75 m/s can be allowed. Assume the value of Manning's roughness coefficient 'n' as 0·04. 10

(c) Discuss the functions, limitations and design features of chute spillways. 10

(d) What are the different types of farm ponds and their essential design requirements ? 10

Q4. (a) Discuss the principles of GIS and remote sensing and their applications in watershed development and management. *10*

(b) Write short notes on the following : *10*
   (i) Universal Soil Loss Equation
   (ii) Catchment Area Treatment
   (iii) Agronomic Erosion Control Measures
   (iv) Functions and Planning of Terraces
   (v) Elements of Flood Routing

(c) It is planned to construct bench terraces on a 20% hill slope. If the vertical interval is 2 m, determine : *10*
   (i) Length per hectare
   (ii) Earthwork
   (iii) Area lost, both for vertical cut and batter slope of 1 : 1. (The cut should be equal to fill)

(d) Discuss different methods of Gully Control. Explain the steps followed in the design of gully control structures. *10*

SECTION B

Q5. **Answer the following :** 8×5=40

(a) Differentiate between the following : 8
   (i) Water requirement and Irrigation requirement
   (ii) Crop water use efficiency and Field water use efficiency
   (iii) Evaporation and Consumptive use
   (iv) Confined and Unconfined aquifers

(b) Discuss the procedure to develop soil moisture characteristic curve and its critical points. 8

(c) Discuss Darcy's law of soil water flow with a definition sketch. In what flow conditions is it applicable ? 8

(d) What is Cavitation ? How does it affect the performance of a pumping system ? How is it prevented in a centrifugal pump ? 8

(e) A field soil sample prior to being disturbed has a volume of 82 cm^3. The sample weighed 125 grams. After drying at 105°C for 24 hours, the dry soil sample weighs 100 grams. What is the soil moisture content on weight basis and volume basis ? What depth of water must be applied to increase the volumetric water content of the top 1 m of soil to 0·40 ? Assume the density of water as 1·00 gm/cm^3. 8

Q6. (a) Draw a neat sketch showing the basic components of a drip irrigation system. Also describe the functions of each of them in brief. 10

(b) Discuss the important aquifer characteristics influencing yields of wells. 10

(c) Discuss sprinkler irrigation uniformity and its measures and describe the procedure to estimate it in the field. 10

(d) Given :

Climate	Hot humid
Soil	Fine sandy loam
Wind speed	7 km/h
Crop	Wheat
Effective root zone depth	1·5 m
Water available in top soil (1·0 m)	167 mm/m
Water available in top soil (0·5 m)	183 mm/m
Irrigation application efficiency	80%
EC_w	2·0 dS/m
EC_e (for 10% yield reduction)	3·4 dS/m
Area	10 ha
Peak rate of water removal	7·6 mm/day
Management allowed deficit (MAD)	50%
Operating hours per day	12 hours

Find the Net and Gross depth of irrigation, Leaching requirement, Irrigation interval and Sprinkler system capacity. 10

Q7. (a) Differentiate between ESP and SAR. Derive the relationship between these two indices. What are salt affected soils ? Explain different reclamation measures to manage salt affected soils. *10*

(b) A 25 cm diameter well is pumped at a uniform rate of 50 *l*/s. The drawdown observed at 1 m and 100 m distances from the centre of the well are 8 m and 40 m respectively. Determine the hydraulic conductivity of the water bearing strata. Assume the thickness of the saturated part of the aquifer as 25 m. *10*

(c) Discuss the Pumping Test of wells. Explain the step-by-step procedure adopted for conducting pumping tests of wells. *10*

(d) What are submersible pumps ? Explain the complete procedure to install a submersible pump in a borewell including initial preparations, installation and testing. *10*

Q8. (a) Discuss various types of poly houses (low to high cost) used for cultivation of high value crops. Explain the working principle of fan and pad evaporative cooling systems. *10*

(b) Discuss dairy barns, their types and their components. Draw a model layout of a dairy farm for a 20 cow/buffalo unit. *10*

(c) Discuss the purpose, benefits and types of subsurface drainage systems. Explain the design of pipe drainage systems used for large irrigation projects. *10*

(d) What is a Farmstead ? What factors govern the location of the farmstead on the farm ? *10*