CODE : FS-17

AGRICULTURAL ENGINEERING

Time : 3 Hours   *Maximum Marks :* 200

Note :— (1) *All* questions carry equal marks. Attempt *five* questions out of eight questions. Q. Nos. **1** and **5** are compulsory. Attempt at least *two* questions from each part, i.e. Part I and Part II. Make necessary assumptions wherever required or for any missing data.

(2) Parts of same questions must be attempted together and not to be attempted in between the answers to other questions.

Part I

1.   (A)   Calculate the volume of earthwork involved in contour bunding for a 100 ha catchment area having a land slope of 3%, if the parameters for contour bunds are to be VI = 1.5 m; base width = 2.25 m; top width = 0.50 m and height of bund = 1.0 m. Determine the percentage area lost due to bunding.

P.T.O.

(B)   Find the discharge carrying capacity of a grassed water way on 4 per cent bed slope with 1.0 m bottom width and 0.4 m flow depth at 4 : 1 side slopes. The roughness co-efficient can be taken as 0.04.

(C)   What do you mean by hydrograph ? Explain in detail about different hydrographs used by soil and water conservation engineers.

(D)   Explain in brief :

     (i)   Bench terracing

     (ii)   Drop spillway

     (iii)   Stubble mulching

     (iv)   Hydrologic design and hydraulic design.   40

2.   (A)   Differentiate between :

     (i)   Spatial resolution and Radiometric resolution

     (ii)   Active sensor and Passive sensor

(iii)   Radiant energy and Radiant flux

(iv)   GIS and GPS

(v)   Thermal conductivity and Thermal diffusivity.

(B)   Write short notes on :

(i)   Vegetation index

(ii)   IFOV

(iii)   Atmospheric windows

(iv)   Lambertian surface

(v)   Contrast modulation.

(C)   What is scattering ? Briefly describe different types of scattering and scatterers.

(D)   (i)   Briefly describe the advantages of microwave remote sensing over optical remote sensing.

(ii)   What are the possible uses of remote sensing techniques ? Describe in brief how remote sensing techniques are applied for Agricultural Engineering. 40

3. (A) On a sandy loam soil the mean depth of water in the soil profile of effective root zone, 5, 10 and 15 days after irrigation was 29.0, 27.5 and 25.3 cm respectively. If 20 cm of water was present in the profile before irrigation and 13.5 cm of water was applied, compute the application efficiencies. The evapo-transpiration losses during these periods are estimated to be 0.15 cm per day.

(B) A tank has a water spread area of 40 hectares with an average depth of 3 meters of water. Calculate the area of paddy crop (120 days duration) that can be irrigated, if the duty is expressed as :

(i) 960 ha per cu.m./s.

(ii) 110 ha.cm, and

(iii) 90 ha/million cu.m. water.

(C) A tensiometer installed above 100 cm of water table level, reads 600 cm of water suction. If the average value of unsaturated hydraulic conductivity is 10^{-2} cm/day, calculate the upward flux.

(D) Differentiate between :

    (i) Structural water and Capillary water

    (ii) Confined aquifer and Unconfined aquifer

    (iii) Positive displacement pump and Roto-dynamic pump

    (iv) Border method irrigation and Check basin irrigation. 40

4. (A) Differentiate between :

    (i) Stanchion barn and Loose housing barn

    (ii) Cylindrical grain bin and Rectangular grain bin

(iii) Cage house and Brooder house

(iv) Shade net greenhouse and insect proof net house.

(B) (i) Design a trench silo for a small farm having the following herd. The silage is fed 160 days in a year. Assume the depth of silo 2.5 m at 50% side slope and length of silage fed per day is 15 cm :

Animal	Body Weight per animal (kg)	Total No. of animal	Rate of feeding per 100 kg of body weight (kg)
Murrah buffaloes	680	40	4.0
Haryana cows	450	60	3.0
Bullocks	500	20	3.5
Heifers	180	20	3.0

(ii) What is the slump test on concrete ? What is its significance in building construction ?

(C)   (i)   What is farmstead ? What factors govern the location of the farmstead in the farm ?

(ii)   Give the floor plan of a bag storage structure large enough to store about 6000 bags (500 tonnes) of grain with suitable assumptions.

(D)   (i)   What is seasoning of timber ? What are the advantages in seasoning of timbers ?

(ii)   Calculate the quantities of cement, sand and gravel required to prepare 81 cu.m. of concrete having 1 : 3 : 4 as the proportion of aggregates.

(iii)   Explain in brief about deep litter poultry housing.

(iv)   Discuss the advantages of different types of farm fencing.   40

Part II

5.   (A)   A horizontal plate planter has 54 cells on its peripheral length of 50.3 cm. The gear on the plate drive shaft has 24 teeth and is rotated by feed shaft gear which has 15 teeth. A 20 tooth sprocket on the main shaft drives the 10-tooth sprocket on the fed shaft. Find the spacing of the seeds in the row and also the speed of travel in km/h, if desired 120 percent fill of the cell requires peripheral cell speed of 0.9 km/h. Assume the diameter of ground wheel as 0.85 meter. Find also the plant population, if the row spacing is 25 cm with 100 per cent seed germination.

     (B)   In a mango orchard, the trees are planted at 10 m × 10 m spacing. A chemical is to be applied at the rate of 92 litres per tree using a blower sprayer. Each delivery nozzle is adjusted to give

a discharge of 7.5 litres/minute at a pressure of 4 kg/cm^2. Assuming the speed of travel as 1.6 km/h, calculate :

(i)   The number of nozzles required if one-half row is sprayed from each side; and

(ii) Number of mango trees that can be covered at one time if the tank capacity is 3.35 m^3.

(C)   (i)   What are the functional elements and principles of working of a combine harvester ? Classify different grain losses occur during the operation of a combine.

(ii) What is the importance of cooling system in a tractor ? Explain the most used cooling system in Indian tractors with neat sketch.

(D)   Briefly describe :

     (i)   Carburetor

     (ii)   Traction theory

     (iii) Dual cycle

     (iv)   Depreciation

     (v)   Antifriction bearing.   40

6.   (A)   (i)   Calculate the theoretical power available of ORP-12 PV 500 wind mill at 12 km per hour wind speed ? If the speed increases to 24 km/h, how much power will be available theoretically ?

       (ii)   Calculate the power generation of a standalone wind energy generator of 50 m diameter at 40 km/h speed. The overall conversion efficiency of the machine is 40 percent.

(B)   (i)   A farmer having a family of six members owns two bullocks, one buffalo and two calves. The gas is required for cooking food and lighting one lamp of 100 candle power for 2 hours daily. Design an appropriate size of biogas plant for the family.

    (ii)   Design an appropriate size of community biogas plant for an army mess of 100 persons and using 10 lamps of 100 CP for 4 hours daily. Work out the amount of cow dung required if the plant is connected with community latrine.

(C)   Briefly describe :

    (i)   Thermal applications of solar energy

    (ii)   Energy plantation

    (iii)   Improved cook stoves

    (iv)   Gasifier

    (v)   Fuel cell.

(D) Differentiate between :

   (i)   Energy and power

   (ii) Tidal energy and Geothermal energy

   (iii) Flat plate collector and concentrator

   (iv) Biogas and producer gas.   40

7. (A) Five hundred quintals of paddy at 22 per cent moisture content (wet basis) are to be dried to 13 per cent moisture content (wet basis) Determine :

   (i)   The dry basis moisture content

   (ii) The weight of dry materials

   (iii) Liters of water to be removed.

   (B) A screw conveyor mounted on a 4 cm dia shaft has screw pitch and dia both equal to 30 cm. Estimate its actual capacity of conveying wheat weighing 850 kg/m^3 while operating at 150 RPM. Assume actual capacity as 50 per cent of theoretical capacity. Also, for a screw length of 8 m what horsepower motor will be required if the horsepower material for wheat is 0.4.

(C)   Differentiate between :

   (i)   Absolute humidity and Relative humidity

   (ii)   Shallow bin and Deep bin

   (iii) Sharp freezing and Quick freezing

   (iv)   Homogenization and pasteurization.

(D)   Briefly explain :

   (i)   Equilibrium moisture content

   (ii)   LSU dryer

   (iii) Parboiling

   (iv)   Seed dressings

   (v)   Spray drying.   40

8.   (A)   A voltmeter with internal resistance of 200 kΩ is connected across an unknown resistance. It reads 250 V and the milliammeter (with very small internal resistance) connected in series with the same resistance reads 10 mA. Determine the apparent resistance, actual resistance and the loading error due to the loading effect of the voltmeter.

(B)   Differentiate :

    (i)   Accuracy and Precision

    (ii)   Resolution and Threshold

    (iii)   Hydraulic load cell and Pneumatic load cell

    (iv)   RAM and ROM.

(C)   Write in brief :

    (i)   Hysteresis

    (ii)   Static sensitivity

    (iii)   Piezo-electric device

    (iv)   Artificial intelligence.

(D)   (i)   A platinum resistance thermometer has a resistance of 140.5 Ω and 100.0 Ω at 100°C and 0°C respectively. If its resistance becomes 305.3 Ω when it is in contact with a hot gas, determine the temperature of the gas. The temperature coefficient of platinum is 0.0039°C^{-1}.

(ii)   Water is flowing with a depth of 0.9 m over a rectangular notch 1.2 m wide. Find the depth of flow over a right angled notch if the same were to pass over it. Assume that both the notches have the same co-efficient of discharge.   40