**Question 5**

(a). What is stream-bank erosion? Describe the methods of sediment movement in stream channels.

(b) List the general criteria that must be considered for the selection of an irrigation system?

(c). Determine the storage capacity of a farm pond to supply water for 1000 steers, 500 milk cows, 100 hogs, 10,000 chickens, irrigation of 5 ha vegetable garden and a farm-family size of 8 persons with adequate provisions made for fire protection. Assume a storage loss of 20% by seepage and evaporation. *Hint: Use the following water need estimates in (ha-m/yr): Household, per person:* 0.01; *steer/450 kg wt:* 0.002; *milk cow (including milk-house and barn sanitation):*0.004; *Swine*: 0.0002; *Chickens/100 head*: 0.001; *Fire protection: 0.03; Irrigation requirement (semi-arid region)/yr*: 0.7 m.

(d). Design a trapezoidal grassed waterway to carry 7.26 $m^3$/sec flow on a 3% slope. The channel should have 4:1 side slopes. The maximum permissible velocity for the vegetation used is 1.15 m/s. Use a roughness coefficient of 0.055. Find b, d, D, t and T.

*D.A.Okunade Aug 24ᵗʰ 2018 - 2017/2018 session*

## INSTRUCTIONS

* TIME ALLOWED: 2½ HOURS
* ANSWER ANY FOUR (4) QUESTIONS
(Provide well-labelled diagrams if needed; and be concise in ALL discussion questions)

## Question 1

(a) Explain why the control of erosion caused by water and wind is of great importance in the maintenance of crop yields. Briefly list five (5) methods of water erosion control.

(b) If the soil loss from a field with a 5% slope is 44.8 Mg/ha for "up and downslope" farming (P =1) and the cropping-management factor C is 0.25. (i) What is the estimated soil loss if the field is contoured and the cropping-management factor is changed to 0.15? (ii)What would be the soil loss if strip cropping was substituted for contouring? (iii) What is the percentage change in soil loss when contouring as a conservation practice is compared with terracing?
*Hint: S = (0.43+0.3s+0.043s²)/6.574, P (strip-crop) = 0.25,*
*P (terr) = 0.12 and P (contr) =0.5.*

(c) A diversion terrace is needed for a flow of 0.85 m³/s; assuming a poor stand of grass and using an allowable velocity of 0.9 m/s. Determine d, D, and the required slope using a 2.44 m bottom width. Allow 0.1 m of freeboard. Use a trapezoidal cross-section with 4:1 side slopes and Manning's roughness coefficient, n = 0.046.

## Question 2

(a). Discuss the purpose and objectives of irrigation in agricultural development. How can you improve the performance of an irrigation system?

(b). Design a trapezoidal grassed waterway to carry 5.67 m³/sec flow on a 3% slope. The channel should have 4:1 side slopes. The maximum permissible velocity for the vegetation used is 1.75m/s. Use a roughness coefficient of 0.055. Find b, d, D, t and T.

(c). A stream of 175 L/sec was diverted from the river and 105 L/sec were delivered to the field. An area of 2 ha was irrigated in 8 hours. The root zone depth was 1.8 m. The runoff averaged 50 L/sec. for 3 hours. The depth of water penetration varied linearly from 1.8 m at the head of the field to 1.2 m at the end of the field. Determine: (i) the water conveyance efficiency, (ii) the water application efficiency, (iii) the water storage efficiency, and (iv) the water distribution efficiency. Water holding capacity is 20 cm/m depth of root zone. Irrigation is done at 60% soil moisture depletion.

## Question 3

(a). In the geometric characteristics of a trapezoidal channel cross-sections, show that cross-sectional area a = $bd+Zd^2$ and wetted perimeter p = b +2d $(Z^2+1)^{1/2}$.

(b). Describe raindrop erosion. Show with the aid of appropriate sketches, the differential soil movement caused by raindrop splash as affected by (i) land slope, and (ii) wind

(c). Differentiate between a confined and an unconfined aquifer.

(d). Determine the velocity of flow in a parabolic-, a triangular and a trapezoidal-shaped waterway, all having a cross-sectional area of 1.86 m², a depth of flow of 0.3 m, a channel slope of 4% and a roughness coefficient of 0.04. Assume 4:1 side slopes for the trapezoidal cross-section.

## Question 4

(a) What are the uses and functions of a vegetated waterway? List the parameters you would consider in its design.

(b) Under what conditions would you select (i) surface irrigation, (ii) sprinkler irrigation instead of other methods of irrigation?

(c) If the specific gravity of moving sediment is 2.5 and the velocity of the stream along its bed is 0.15 m/sec. What is the maximum size of soil particles that can be moved?

(d) An unconfined well of diameter 30 cm was tested with a uniform discharge of 1000 L/min. The steady state draw-downs measured in two observation wells which were at 14 and 40 m radial distances from the centre of the pumped well were 2.62 and 1.50 m, respectively. Determine (i) the hydraulic properties of the aquifer, if its saturated thickness is 18 m, (ii) estimate the level of drawdown in the pumped well.