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**JOMO KENYATTA UNIVERSITY**

**OF**

**AGRICULTURE AND TECHNOLOGY**

# University Examinations 2012/2013

**FOURTH YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL ENGINEERING**

# ECE 2405: IRRIGATION ENGINEERING

**DATE: AUGUST, 2012**  **TIME: 2 HOURS**

**INSTRUCTIONS: Answer Question ONE and Any Other TWO Questions.**

**Question One**

a) Outline three main challenges experienced in irrigation water sources. [3 marks]

b) Distinguish between the following term as used in irrigation engineering.

i. Potential Evapotranspiration (ETP)

ii. Reference crop evapotranspiration (ET0) [6 marks]

c) Describe five major sources of ground water contamination. [5 marks]

d) Describe FIVE major water catchment in Kenya. [5 marks]

e) Define the term renewable water resources. Describe the Kenyan renewable water resources status in 2010. [5 marks]

f) After how many days would an irrigation engineer supply water to the soil in order to ensure sufficient irrigation of the given crop?

The field capacity of the soil - 30%

Permanent wilting point - 12%

Density of the soil - 1250kg/m3

Effective depth of the root zone - 60 cm

Daily consumption use of water - 12.5 mm

Assume that management allowable depletion (MAD) is 0.8. [6 marks]

**Question Two**

a) Soil water storage and movement is of importance in scheduling irrigation to attain efficiency and effectiveness.

Explain the relationship between the soil-water storage and movement when dry soil is irrigated until the development of run off. [10 marks]

b) Describe five physical factors affecting selection of farm irrigation system, identify their respective impacts on irrigation system. [10 marks]

**Question Three**

a) Define the term irrigation scheduling. [2 marks]

b) Outline the main advantages of irrigation scheduling. [4 marks]

c) Explain the meaning of the following terms as used in irrigation engineering.

* Soil alkalinity
* Soil acidity
* Cation exchange capacity [9 marks]

d) A municipal waste water quality was tested and the following data was obtained as listed in table 1. Primary measurement of Electrical conductivity (ECw) = 1.25ds/m and a pH value of 7.0.

Table 1 – municipal waste water quality

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Cations | | | Anions | | |
| Units | Na | Ca | Mg | CL | SO4 | HCO3 |
| mg/L | 178.0 | 47.0 | 18.0 | 167 | 235.8 | 161.1 |

See table 3 attached in Appendix. [5 marks]

**Question Four**

a) Determine reservoir capacity for command are of 40,000 ha, canal losses 10% and reservoir losses 10%.

Base period outlet factor and intensity of irrigation are given in table 2. [12 marks]

Table: 2

|  |  |  |  |
| --- | --- | --- | --- |
| Crop | Base period (days) | Out factors (ha/cumec) | Irrigation intensity (%) |
| Sugar cane | 360 | 1700 | 20 |
| Cotton | 180 | 1500 | 10 |
| Wheat | 120 | 1800 | 20 |
| Rice | 120 | 700 | 15 |
| Vegetables | 120 | 700 | 15 |

b) Explain why lowering the water table is helpful in prevention of accumulations of soluble salts on the surface of the soil. [3 marks]

c) Describe five (5) factors affecting the rate of Evapotranspiration (ET). [5 marks]

**Question Five**

a) A 12 hectare field is to be irrigated with a sprinkler system. The root zone depth is 0.9m and the field capacity of the soil is 28% while the permanent wilting point is 17% by weight.

The soil bulk density is 1.36g/cm3 and the water application efficiency is 70%. The soil is to be irrigated when 50% of the available water is depleted. The peak evapotranspiration is 5.0mm/day and the system is to run for 10 hours in a day.

Determine:

1. The net irrigation depth
2. Gross irrigation i.e the depth of water to be pumped
3. Irrigation period
4. Area to be irrigated per day
5. The system capacity [14 marks]

b) A leguminous crop is being produced on a net water use of 600mm. Each of four (4) irrigation applies 150mm of water over the surface.

i. Assuming average moisture extraction pattern, calculate the average depth of water stored in each 200 mm of the 1.2m of root zone. [3 marks]

ii. If the total water-holding capacity of the soil is 160mm per metre, determine the percentage of water stored in each metre depth within the root zone during each irrigation. [3 marks]

Table 3. Atomic weights, valence numbers and conversion factors for common ions

|  |  |  |  |
| --- | --- | --- | --- |
| Ion | Element | Atomic Weight  (AW) | Valence (V) |
| Na+  Ca2+  Mg2+  Cl-  SO42-  HCO3- | Sodium  Calcium  Magnesium  Chloride  Sulfate  Bicarbonate | 23.0  40.1  24.3  35.5  96.1  61.0 | 1  2  2  1  2  1 |