AGEN 555

EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

NJORO CAMPUS

SECOND SEMESTER 2012/2013

FIFTH YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING

AGEN 555: IRRIGATION AND DRAINAGE ENGINEERING II

STREAM: 2008 (Y5) B. SC. AGEN **TIME:** 2 HOURS

DAY/TIME: THURSDAY, 03.00 – 05.00 PM **DATE:** 23-05-2013

INSTRUCTIONS:

1. The paper consists of **SIX (6)** questions in two sections.
2. Attempt **ALL** questions in **Section A** and **any THREE (3)** in **Section B.**
3. Marks for each question are shown in parenthesis.
4. Show all workings for each question in Section B
5. Each question should be answered complete as a package
6. **EACH QUESTION SHOULD BE STARTED ON A NEW PAGE.**
7. Aid material for the exam is given at the end of the paper.

SECTION A - ATTEMPT ALL QUESTIONS IN THIS SECTION (40 MARKS)

QUESTION ONE

(a) List and briefly describe **any four** unique features of a sprinkler irrigation system that makes it ideal in most situations in spite of the high energy operating requirements and the relatively high initial cost. **(4 marks)**

(b) Briefly describe a Semi-Portable Sprinkler irrigation system, and show reasons why it is considered the ideal system in certain situations. **(4 marks)**

(c) Name and briefly describe **any four** of the most important components of furrow irrigation design. **(4 marks)**

(d) Name and briefly describe the components of total pressure head that is required to be delivered by the pump in a sprinkler irrigation system. **(4 marks)**

(e) List and briefly describe the freeboard,requirements that must be met in the maintenance of water level in drainage ditches. **(4 marks)**

QUESTION TWO

A steel mainline is being designed to deliver a discharge of 63 l/s at a head of 35 m of water to a sprinkler irrigation project located 3050 m from the water source. The mainline is to be laid on a level grade. Assume the useful life of the pipes is 20 years and that it will have no salvage value. Money to implement the project will be borrowed from the bank at an interest rate of 5 percent. The pump costs K£ 80.43 per kW, while energy cost for operating the system is KSh 10 per kWh. The system will be operated for 1500 hours per year. The pipe costs are given in the following table.

Pipe diameter (mm) 1	Cost per meter (K£) 2	Total head (m) 3	Cost of pump (K£) 4	Annual capital cost (K£) 5	Annual energy cost (K£) 6	Total Annual cost (K£) 7
101.6	6.56					
152.4	6.18					
203.2	15.58					
254.0	24.27					
304.8	33.96					

Assuming a Hazen-Williams C-value of 140 for the steel pipe, and a pumping plant efficiency of 80 percent complete the above table and select the most economical pipe. **(20 marks)**

SECTION B - ATTEMPT ANY THREE (3) QUESTIONS (30 MARKS)

QUESTION THREE

A 76.2 mm diameter aluminium lateral pipe has been designed for a sprinkler irrigation system. The lateral carries 30 sprinklers spaced at 18 meters, with the first sprinkler located one full sprinkler spacing from the entrance to the sub-main. Water entering the lateral from the sub-main is maintained at a pressure head of 30 m corresponding to a design sprinkler discharge of 0.16 l/s. Assuming the field surface is level and that the friction factor C for aluminium is 135, determine the tollowings:

(a) Required lateral discharge in l/s

(b) Head loss due to friction for s flow passing trough an equivalent pipe to the lateral, m

(c) Actual head loss accounting for discharge through the nozzles, m

(d) Last sprinkler discharge, l/s

(e) Entrance flow velocity into the lateral, m/s. **(10 marks)**

QUESTION FOUR

A typical tree orchard is to be developed on a farm with dimensions 250 m by 450 m. The orchard will be irrigated using drip irrigation system so that each tree is served by 4 emitters. The system will be supplied with water from a 20 m deep well located in the centre of the farm. The following design conditions based on peak period water requirement at full tree maturity are specified:

Tree spacing	= 4 m by 5 m
Operating pressure head for the emitter	= 10 m
Maximum pressure variation between the 2 critical emitters	= 20 percent
Distribution pattern efficiency	= 92 percent
System operating time	= 18 h/d
Cost of electric energy	= KSh 10/kWh
Peak period crop water requirement	= 5 mm/d

Sketch the field layout with the system in place and determine the following parameters

(a) Required emitter discharge (l/h)

(b) Discharge per lateral line (l/h)

(c) Discharge requirement from the well (l/s)

(d) Size of 80 percent submersible pump required to operate the system (kW)

(e) Monthly cost of operating the system (KSh) **(10 marks)**

QUESTION FIVE

(a) Results of infiltration test on a soil indicate that it has an a-factor of 0.85 in the Kostiakov equation, and a c-factor of 1.5 for depth in mm and time in minutes. The field is to be furrow irrigated. Net time of irrigation is 480 minutes, and time for water to advance to the end of the furrow is 96 minutes. Determine the water lost as deep percolation in mm depth.

(5 marks)

(b) A surface irrigation system is designed to apply water through a Parshall flume to a level basin which is 0.3 ha in area. The water is applied for 120 minutes with the flow measured through the flume at 11.8 l/s. The root zone has the capacity to store an equivalent depth of 26 mm of water.

(i) State which efficiencies are applicable.

(ii) Determine the value of efficiencies in (i) using only the information provided.

(5 marks)

QUESTION SIX

(a) Determine the size of a smooth concrete collector drain pipe laid on a grade of 0.1 percent, which is expected to convey drain water uniformly, from a 20 ha plot drained by field drains, designed for a drainage coefficient of 5 mm/day.

(b) Determine the size of the collector drain pipe in (a) if the water flow from field drains changed from uniform to non-uniform

(c) Determine the expected size of the collector drain in (a) if it was changed from smooth to corrugated PVC pipe.

(d) Determine the expected size of the collector drain pipe in (a) if the drainage coefficient was changed from 5 mm/d to 13 mm/d.

(e) Determine the expected size of the collector drain pipe in (a) if it was re-aligned to follow a grade of 0.4 percent.

(10 marks)

****