UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science

B.Sc. Degree in Environmental Management and Water Resources

MAIN EXAMINATION PAPER MAY 2014

TITLE OF PAPER : Water Distribution and Sewerage Systems

COURSE CODE : EHM 320

DURATION : 2 HOURS

MARKS : 100

INSTRUCTIONS : THERE ARE FIVE QUESTIONS IN THIS EXAM

  : ANSWER ANY FOUR OUT OF THE FIVE QUESTIONS

  : EACH QUESTION CARRIES A MAXIMUM MARK OF 25%

Question One (25 Marks)

A. State with the help of examples the importance of maintaining <u>pressure</u> and <u>velocity</u> of water in pipes in relation to the quality of water supplied............................... [5Marks].

B. List the function of storage (service reservoirs) in water supply networks ......[6 Marks].

C. The water supply system layout shown in figure Q1-1 below serves a daily average demand of 10 million liters per day. The unaccounted for water in the distribution pipes is estimated to be 20% of the average daily demand and the hourly peak factor is 1.4. The annual daily peak factor is 1.1. Assume that water losses along the pipes 1, 2 and 3 are 2% of the total flow carried by each of the pipes. In addition, assume that water loss in the treatment plant as 7% of the total water treated. Determine the flow in m^3/sec for which each of the following components should be designed:

   i.   Pipe 1 ....[2 Marks]
   ii.   Treatment units.........[2 Marks]
   iii.   Pump......................[2 Marks]
   iv.   Pipe 2....................[2 Marks]
   v.   Reservoir.................[2 Marks]
   vi.   Pipe main 3...............[2 Marks]
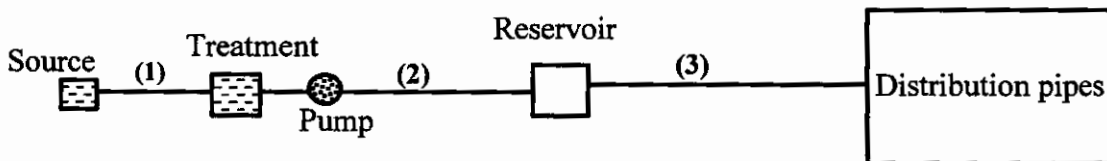   vii.   Distribution pipes........[2 Marks]

Figure Q1-1

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Question Two (25 Marks)

(Note each question carries 5 marks)

A. Describe the various components of unaccounted for water.

B. Describe conditions under which a <u>pile support</u> should be provided to pipes.

C. For what conditions is pipe tunneling appropriate and what are the advantages and disadvantages of pipe tunneling?

D. Describe with the help of a sketch the <u>well point method trench dewatering</u>. Start the conditions under which the well point may have to be used for pipe trench dewatering.

E. For the network diagram shown below in figure Q2-1 below, show with the help of a sketch the necessary anchor support positions for the junctions A, B, C and D.
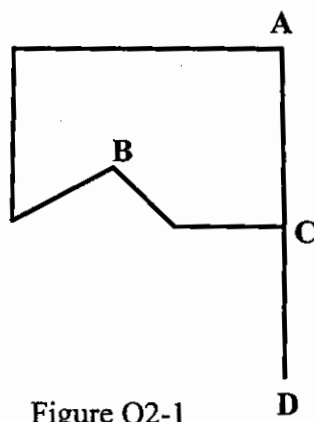

Figure Q2-1

Question Three (25 Marks)

A. For the water distribution layout shown in Figure Q3-1 below, calculate the network reliability with respect to each of the pipes designated 1, 2, 3, 4 and 5.
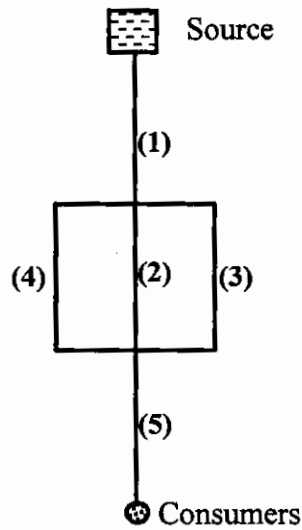
..............[5 Marks]

Figure Q3-1

B. It is desired to lay a pipe network connecting the source (reservoir) to the demand areas A, B, C and D shown in figure Q3-2 below. Draw a pipe network layout with maximum reliability (minimum interruption) and state the overall network reliability for the network you have drawn ....[5 Marks]
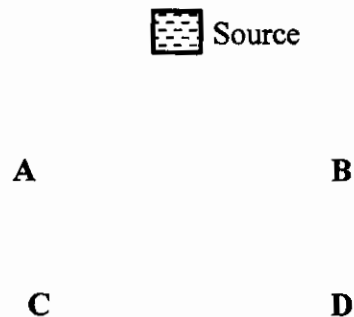

Figure Q3-2

C. Calculate the component availability of a pipe distribution system if the annual down times for preventive and corrective maintenance were 20 hours and 10 hours, respectively.

.... [5 Marks]

D. Describe the methods employed for pipe cleaning and state their advantages and disadvantages. ……………………………………………………………....….. [5 Marks]

E. Describe the short term and long term measures for the control of animals in distribution systems. …………………………………………………………………….... [5 Marks]

Question Four (25 Marks)

For the pipe network shown in Figure Q4-1 below, the elevation in meters, pipe length, diameter and the nodal demand at D are shown. Determine the flows in the pipes AB and BC in liters/sec and the pressure at node D in meters of water. Use the Darcy-Weisbach formula for the calculation of friction losses and take the friction factor as f = 0.02 for all the pipes shown in the figure.
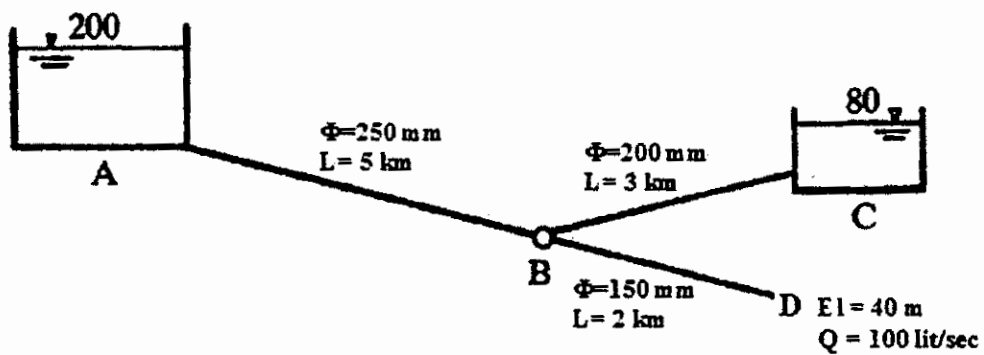

Figure Q4-1

Question Five (25 marks)

A. Describe the following sewer systems:

    i.   Vacuum sewerage ………………………………….……………..[1.5 Marks]

    ii.   Pressurized sewerage ………………………….……….………..[1.5 Marks]

    iii.   Small bore sewerage. ……………………………….…….………..[2 Marks]

B. Describe the factors that can lead to

    i.   Sanitary sewer overflows. ……………………..………..[1.5 Marks]

    ii.   Combined sewer overflows. ……………………..………..[1.5 Marks]

    iii.   Indicate the steps needed to minimize these overflows.   [2 Marks]

C. What are the factors that should be explored in the geotechnical investigation for the design and construction of sewer systems?   ……………………….….......[5 Marks]

D. Match the items in B against the items in A. …………………………….……...[5 Marks]

Item A	Item B
Curved sewers	Consider private ownership of land
Manholes	Maintenance hole provision
Aggressive soil	Economic/practical justification
Design depth of flow	Illegal/inappropriate
Location of pumping stations	Allow for free air ventilation
Width of trench	Cathodic protection
Dead end mains	Provision for venting

E. Describe the factors that should be taken into account in the layout of sewer systems.

    …………………………….…...[5 Marks]