NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

COMPUTER APPLICATION IN CIVIL ENGINEERING

TCW 2104

Supplementary Examinations paper

August 2017

This examination paper consists of 4 pages

Time Allowed: **3 hours**

Total Marks: **100**

Examiner's Name: **Mrs S. Nhandara**

INSTRUCTIONS

1. Answer ALL questions
2. ALL Charts and Spread Sheets must be fully labeled

MARK ALLOCATION

QUESTION	MARKS
1	50
2	25
3	25
TOTAL	100

QUESTION 1

An investigation is required to measure the extent of land contamination from the operations of a Gold mine. To do this monitoring wells are located at distances of 1 000m, 3 000m, 5 000m and 10 000m from the mine and the concentration of the contaminant (C) is measured. The time taken by the contaminant to reach the monitoring wells (t) is recorded. It is given that the initial concentration of the contaminant is 1000ug/l. The table below shows the ratio of (C/C0), which is the concentration at a given time at a fixed distance (1 000, 3 000, 5 000 and 10 000m from the source).

Well distance(m)	**1 000**		**3 000**		**5 000**		**10 000**	
t (days)	**C/Co**	**C**	**C/Co**	**C**	**C/Co**	**C**	**C/Co**	**C**
1	0,000	0,0	0,000	0,0	0,000	0,0	0,000	0,0
100	0,000	0,0	0,000	0,0	0,000	0,0	0,000	0,0
200	0,000	0,0	0,000	0,0	0,000	0,0	0,000	0,0
300	0,002	2,3	0,000	0,0	0,000	0,0	0,000	0,0
400	0,051	51,2	0,002	2,1	0,000	0,0	0,000	0,0
500	0,233	232,6	0,034	33,9	0,002	1,7	0,000	0,0
600	0,500	500,0	0,159	158,7	0,023	22,8	0,000	0,0
700	0,731	731,5	0,379	378,8	0,109	108,5	0,002	1,8
800	0,876	875,9	0,614	613,6	0,282	281,9	0,022	21,6
900	0,949	948,8	0,793	792,9	0,500	500,0	0,484	483,7
1000	0,981	980,6	0,902	901,6	0,697	697,2	0,682	682,3
1100	0,993	993,1	0,958	957,6	0,838	837,6	0,899	899,1
1200	0,998	997,7	0,983	983,1	0,921	921,4	0,925	924,9
1300	0,999	999,2	0,994	993,6	0,965	965,0	0,991	990,8
1400	1,000	999,8	0,998	997,7	0,985	985,5	0,992	992,4
1500	1,000	999,9	0,999	999,2	0,994	994,3	0,993	993,8
1600	1,000	1000,0	1,000	999,7	0,998	997,9	0,995	995,2
1700	1,000	1000,0	1,000	999,9	0,999	999,2	0,996	996,3
1800	1,000	1000,0	1,000	1000,0	1,000	999,7	0,997	997,1
1900	1,000	1000,0	1,000	1000,0	1,000	999,9	0,999	999,0
2000	1,000	1000,0	1,000	1000,0	1,000	1000,0	1,000	1000,0

a. Plot the time series for the well at 1 000m from the mine (15 marks)

b. ADD the time series of the wells at 3 000m and 5 000 and 10 000m from the mine (15 marks)

c. Describe the extent of contamination at each well (8 marks)

d. If the concentration of the maximum contaminant level (MCL) is 70ug/l at what time would that concentration be exceeded at each the 1 000m, 3 000m, 5 000m and 10 000m location. (8 marks)

e. Explain how the shape of the graph would change if a retardation agent is added to slow the rate of flow of the contaminant. Also highlight at which well the effect of retardation will be most pronounced (4 marks)

[50 marks]

QUESTION 2

a. i) A concrete lined trapezoidal channel is to be designed to produce a discharge of $30m^3/s$ in uniform flow. Design a suitable Microsoft Excel spreadsheet based on Manning's equation to determine the depth that will yield this discharge through a series of iterations. The base width is 5m and the side slopes are equal at 1:2. Manning's n is 0.015 and the bed slope $S_o = 0.001$.

The following equations apply

(1) Area, $A = (b + xy)y$,

(where b= base width = 5m, x= slope horizontal component = 2, y = the required depth)

(2) Wetted perimeter, $P = b + 2y\,(1+x^2)^{1/2}$

(3) Hydraulic radius, $R = \dfrac{\text{Area, } A}{\text{Wetted perimeter, } P} = \dfrac{(b + xy)y}{b + 2y\,(1+x^2)^{1/2}}$

(4) Manning 's equation: $Q=VA$, Velocity, $V = \dfrac{R^{2/3}S_o^{1/2}}{n}$

(5) Discharge, $Q = \dfrac{1/n\, A^{5/3}\, S_o^{1/2}}{P^{2/3}}$

[25 marks]

QUESTION 3

Soil is a typical heterogeneous multiphase porous system which, in its general form, contains three natural phases: (1) the solid phase or the soil matrix (formed by mineral particles and solid organic materials); (2) the liquid phase, which is often represented by water and which could more properly be called the soil solution; and (3) the gaseous phase, which contains air and other gases. Density, as applied to any kind of homogeneous mono-phase material of mass *M* and volume *V*. Under specified conditions, this definition leads to unique values that represent a well-defined property of the material.

For heterogeneous and multiphase materials, however, such as porous media, application of this definition can lead to different results, depending on the exact way the mass and volume of the system are defined. The distribution of a soil sample by density is shown below.

Soil density (KN/m3)	**% of soil sample**
0-2	0,2
3-4	2,4
5-6	3,2
7-8	5,6
9-10	8,5
11-12	13,8
13-14	17,7
15-16	20,9
17-18	24,1
19-20	1,9
20+	1,7

a. Produce a suitable chart to illustrate the data (7 marks)

b. Describe the soil profile (5 marks)

c. Given that the average density of soil 'dense' soil is 17.6KN/m^3 while the average density of light soil is 10.8KN/m^3 explain the classification of the given soil system. Show calculations to justify your answer (6 marks)

d. Give practical cases which highlight the importance of soil classification (5 marks)

e. Outline two methods that can be used to improve soil strength (2 marks)

[25 marks]

END OF EXAMINATION