NATIONAL UNIVERSITY OF SINGAPORE

FACULTY OF ENGINEERING

EXAMINATION FOR

(Semester I: 2012-2013)

CE5310 - HYDROINFORMATICS

Nov/ Dec 2012 - Time allowed: 2.5 hours

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INSTRUCTIONS TO CANDIDATES

1.   This examination paper contains **SIX(6)** questions and comprises **FOUR(4)** printed pages.

2.   Answer ALL **SIX(6)** questions.

3.   All questions DO NOT carry equal marks.

4.   This is a "**CLOSED BOOK**" examination.

Question 1 (10 points)

Describe how you would represent trees in GIS in case:

    a) You do a study on distribution of tree species
    b) You do a study about the interception of rainfall by tree canopy

Describe for both cases the spatial data and attribute data.

Question 2 (20 points)

GIS is often used in water quality modeling to calculate rainfall runoff and associated water quality parameters from catchments. The quality of the runoff from a catchment is determined by the land use in that catchment, e.g. the water quality characteristics from a forested catchment will be different than those from an industrial catchment.

    a) To determine the water quality, regular samples need to be taken at the main outlet point of the catchment. If you would be responsible for GIS data input of the samples, describe the steps you need to take to create a map with sampling points.

    b) If you have the following map layers: catchment boundaries, land use, sampling points, and locations of bin centres (rubbish collection points), what spatial analyses can you use to analyse the relation between the measured water quality parameters and land use in a catchment?

Question 3 (8 points)

List the data types in database, and give one example for each data type.

Question 4 (12 points)

Suppose we have a database called "KentRidgeCatchment" which contains a table called "RG" created by the following statement. The table stores the readings from the rain gages (RG01 to RG04).

```
CREATE TABLE RG(
        id      INT     NOT NULL,
        obsDateTime  DateTime,
        RG01    double,
        RG02    double,
        RG03    double,
        RG03A double,
        RG04    double
);
```

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Write a SQL query that retirieves the data for RG03 and RG04 within the period of 2012 June 01 to 2012 June 30 (both dates inclusive).

Write another query that gets the minimum, average, and maximum readings from RG03 and RG03A.

Question 5 (25 points)

The following data of flow rates in a canal situated within Kent Ridge experimental catchment were collected for month of November 20122.

Date	Flow Rate [m3/s]
1-Nov-11	2.30
2-Nov-11	1.98
3-Nov-11	1.95
4-Nov-11	1.93
5-Nov-11	1.91
6-Nov-11	1.90
7-Nov-11	3.75
8-Nov-11	3.20
9-Nov-11	3.10
10-Nov-11	2.10
11-Nov-11	2.05
12-Nov-11	2.00
13-Nov-11	1.97
14-Nov-11	5.78
15-Nov-11	4.30
16-Nov-11	2.10
17-Nov-11	2.08
18-Nov-11	2.04
19-Nov-11	2.01
20-Nov-11	1.99
21-Nov-11	1.97
22-Nov-11	1.95
23-Nov-11	1.83
24-Nov-11	1.91
25-Nov-11	1.89
26-Nov-11	1.87
27-Nov-11	1.86
28-Nov-11	1.85
29-Nov-11	1.84
30-Nov-11	1.84

The data set is characterised by following statistical properties:

Median	1.98
Mean	2.31
Variance	0.784
1st Quartile	2.06
3rd Quartile	2.095
Minimum	1.83
Maximum	5.78

Questions:

Sketch boxplot for this data set. Indicate relevant elements of the box plot

What is box plot? What is minimum number of data points required to create box plot

Assuming that data are normally distributed, what would be the range covering approximately: (i) 68% of the data set and (ii) 95% of this data set

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Question 6 (15 points)

What is Kalman filter? Describe the purpose and fundamental idea behind this algorithm. In plain language describe the way in which the filter works.

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