

NATIONAL EXAMS DECEMBER 2017

04-Geom-B1 Digital Terrain Modelling

3 HOURS DURATION

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. Candidates may use one of two calculators, the Casio or Sharp approved models. This is a CLOSED BOOK exam.
3. 10 Questions constitute a complete paper.

Part A: Answer ALL Questions from #1 through #8;
Part B: Answer ONE of Questions #9 through #10;
Part C: Answer ONE of Questions #11 through #12;
4. The marks assigned to each question are shown in brackets in the left margin.

PART A - PLEASE ANSWER ALL QUESTIONS FROM #1 - #8

(10) **Question 1**

- 1.1) What are the three most common DEM data models? (3 marks)
- 1.2) Use a tabular format to compare these data models with respect to the following characteristics: structure, georeferencing, storage, data analysis, applications, terrain representation. (7 marks)

(12) **Question 2**

Explain the merits of using the following methods/systems for DEM data generation:

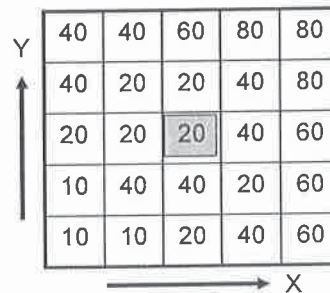
- 2.1) ground surveys (3 marks)
- 2.2) aerial photogrammetric methods (3 marks)
- 2.3) satellite image-based methods (3 marks)
- 2.4) airborne lidar terrain altimetry (3 marks)

(10) **Question 3**

- 3.1) Describe the terrain sampling process and its parameters. (4 marks)
- 3.2) Give and describe a sampling method for terrain elevation data and provide advantages and disadvantages of this method. (6 marks)

(12) **Question 4**

Given the gridded DEM next (values in meters) with grid size 20m x 20m, determine the slope and aspect angles at the centre point (use 4-neighbour points only).



(8) **Question 5**

In a line-of-sight analysis from a DEM, the elevation of the viewer is at 10 m and the elevation of the target is at 30 m. The distance between the target and the obstacle is 350 m and the distance between the viewer and the obstacle is 200 m. If the height of the obstacle is 20 m determine if the target is visible or not to the viewer.

(8) **Question 6**

Calculate the volume of the material removed from an open pit mine if the cross-sectional areas at given depth intervals of 15 m are as follows:

Depth (m)	0	15	30	45	60	75	90
Area (m ²)	220	180	160	72	64	42	11

- (12) **Question 7**
7.1) Describe the operational principle of airborne lidar terrain measurement systems. (6 marks)
7.2) Explain the difference between single and multiple return sensor and give what additional information can be derived when a multiple return lidar sensor is used. (6 marks)
- (8) **Question 8**
8.1) What is gridding? (4 marks)
8.2) What is the moving average gridding? (4 marks)

PART B - PLEASE ANSWER ONLY ONE OF QUESTIONS #9 - #10

- (10) **Question 9**
The most widely method used to form a triangulated irregular network (TIN) from irregularly distributed points is the Delaunay triangulation.
9.1) List and describe two characteristic conditions used to construct a Delaunay triangulation. (5 marks)
9.2) The Delaunay triangulation can be constructed by the Voronoi diagram. Explain what are the Voronoi diagram and the Voronoi region. (5 marks)
- (10) **Question 10**
Explain how you could use a DEM to determine:
10.1) flow directions and flow lines. (5 marks)
10.2) a watershed boundary. (5 marks)

PART C - PLEASE ANSWER ONLY ONE OF QUESTIONS #11 - #12

- (10) **Question 11**
11.1) Explain the terrain surface interpolation process of estimating the elevation at unsampled points. (4 marks)
11.2) Identify which of the interpolation methods listed below are of global, local, deterministic, stochastic, exact or inexact type (use a tabular format: methods vs characteristics for the answer). (6 marks)
- Trend surface
 - Inverse distance weighting
 - Kriging
- (10) **Question 12**
Explain what kriging is, what the main parameters are to be estimated by kriging and how they are used.