

**E1 - SPATIAL DATABASES
& LAND INFORMATION SYSTEMS**

March 2016

Although programmable calculators may be used, candidates must show all formulae used, the substitution of values into them, and any intermediate values to 2 more significant figures than warranted for the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

Note: This examination consists of 11 questions on 3 pages.

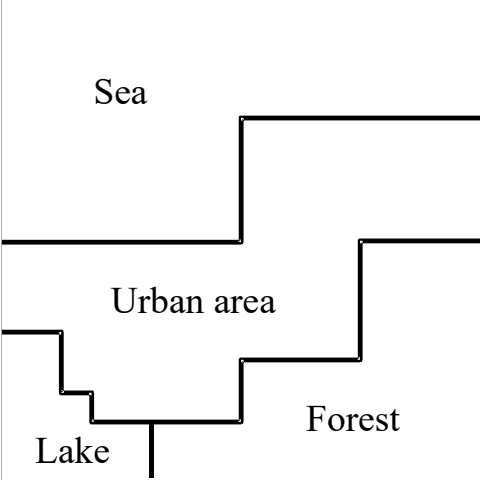
Marks

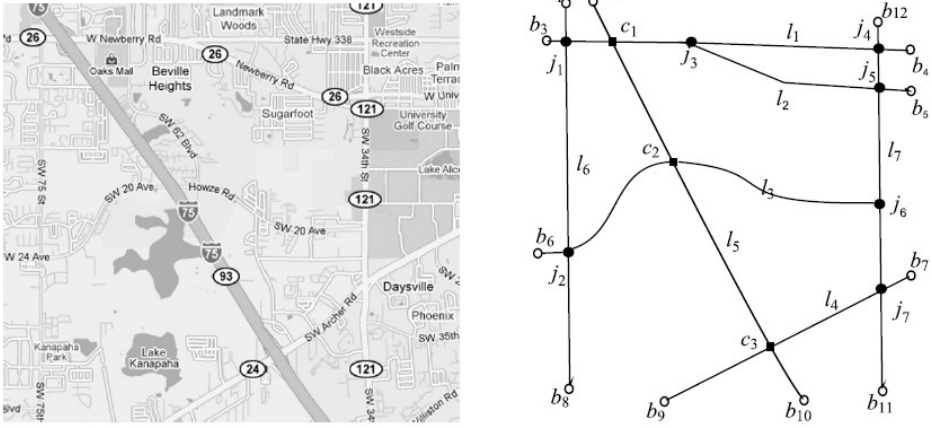
Q. No

Time: 3 hours

Value Earned

<p align="center">1.</p>	<p>Database design is the process of producing a detailed data model of a database. The process of doing database design generally consists of a number of steps which will be carried out by the engineer. The steps are usually grouped in terms of the type of the database design at hand, i.e. Conceptual Design (CD), Logical Design (LD) and Physical Design (PD). Identify the type of the database design the following steps belong to:</p> <ol style="list-style-type: none"> a) Decision about how real-world objects and relationships will be represented in a spatial database. For example, should a city be represented as an area or a point? b) Selection of spatial objects (points, lines, areas, raster cells). c) Determine what type of database management system should be used. d) Determine how files will be structured for access from the disk. e) Specify the types of information used by various functions. f) Specify accessing capabilities. g) Develop an ER model with integrity constraints. h) Specify the data elements, data types, and indexing options. i) Work interactively with users. j) Build the metadata. 	<p align="center">10</p>	
<p align="center">2</p>	<p>The following UML class diagram conceptually describes the OGC Geometry Schema. In this diagram, three different types of relationships between classes have been used. Identify these relationships and explain their main functions.</p>	<p align="center">2.5 2.5 2.5</p>	

<p>3.</p>	<p>Given the land use map below:</p>  <p>Represent its raster image using a quadtree data indexing structure.</p> <table border="1" data-bbox="792 705 1273 1188"> <tr><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td></tr> <tr><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td></tr> <tr><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td></tr> <tr><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td></tr> <tr><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td></tr> <tr><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td></tr> <tr><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td></tr> <tr><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>s</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td></tr> <tr><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>f</td><td>f</td><td>f</td><td>f</td><td>f</td></tr> <tr><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>f</td><td>f</td><td>f</td><td>f</td><td>f</td></tr> <tr><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>u</td><td>f</td><td>f</td><td>f</td><td>f</td><td>f</td></tr> <tr><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td></tr> <tr><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td></tr> <tr><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td></tr> <tr><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td></tr> <tr><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td><td>l</td></tr> </table>	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	u	u	u	u	u	u	u	u	u	s	s	s	s	s	s	s	s	s	u	u	u	u	u	u	u	u	u	s	s	s	s	s	s	s	s	s	u	u	u	u	u	u	u	u	u	s	s	s	s	s	s	s	s	s	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	f	f	f	f	f	u	u	u	u	u	u	u	u	u	u	u	u	u	f	f	f	f	f	u	u	u	u	u	u	u	u	u	u	u	u	u	f	f	f	f	f	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	<p>10</p>	
s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s																																																																																																																																																																																																																																																																																		
s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s																																																																																																																																																																																																																																																																																		
s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s																																																																																																																																																																																																																																																																																		
s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s																																																																																																																																																																																																																																																																																		
s	s	s	s	s	s	s	s	s	u	u	u	u	u	u	u	u	u																																																																																																																																																																																																																																																																																		
s	s	s	s	s	s	s	s	s	u	u	u	u	u	u	u	u	u																																																																																																																																																																																																																																																																																		
s	s	s	s	s	s	s	s	s	u	u	u	u	u	u	u	u	u																																																																																																																																																																																																																																																																																		
s	s	s	s	s	s	s	s	s	u	u	u	u	u	u	u	u	u																																																																																																																																																																																																																																																																																		
u	u	u	u	u	u	u	u	u	u	u	u	u	f	f	f	f	f																																																																																																																																																																																																																																																																																		
u	u	u	u	u	u	u	u	u	u	u	u	u	f	f	f	f	f																																																																																																																																																																																																																																																																																		
u	u	u	u	u	u	u	u	u	u	u	u	u	f	f	f	f	f																																																																																																																																																																																																																																																																																		
l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l																																																																																																																																																																																																																																																																																		
l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l																																																																																																																																																																																																																																																																																		
l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l																																																																																																																																																																																																																																																																																		
l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l																																																																																																																																																																																																																																																																																		
l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l																																																																																																																																																																																																																																																																																		
<p>4.</p>	<p>List five methods of data input for a GIS. How might you describe some of the challenges of acquiring spatial data?</p>	<p>10</p>																																																																																																																																																																																																																																																																																																	
<p>5.</p>	<p>Explain how sensor data, cadastral data, remote sensing imagery, and GPS data can be stored in the following database types:</p> <ul style="list-style-type: none"> a) Graph database b) Relational database c) Object oriented database <p>Describe the main advantages and limitations of each one.</p>	<p>2.5 2.5 2.5</p>																																																																																																																																																																																																																																																																																																	
<p>6.</p>	<p>Compare and contrast the following pairs:</p> <ul style="list-style-type: none"> a) object-oriented data model and relational data model b) Spatial functions and spatial constraints c) Spatial SQL and NoSQL 	<p>2.5 2.5 2.5</p>																																																																																																																																																																																																																																																																																																	
<p>7.</p>	<p>How can we create multiple webmap applications linked to the same data?</p>	<p>10</p>																																																																																																																																																																																																																																																																																																	

8.	<p>How is a spatial database different from a Land Information System? Give three functionalities of a spatial database and three functionalities of a Land Information System.</p>	10																			
9.	<p>For each row of the table below, explain the distinction between these two SQL.</p> <p>The table building has the following fields: ID, ADDRESS, TYPE</p> <table border="1" data-bbox="394 386 1154 915"> <thead> <tr> <th>#</th> <th>SQL no1</th> <th>SQL no2</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>DROP TABLE building;</td> <td>DELETE FROM building;</td> </tr> <tr> <td>2</td> <td>INSERT INTO building VALUES (102, '45 Main Street, St-John', 'residential');</td> <td>UPDATE building SET type= 'residential' WHERE id= 102</td> </tr> <tr> <td>3</td> <td>DELETE FROM building WHERE id = 102;</td> <td>INSERT INTO building VALUES (102, '45 Main Street, St-John', 'residential');</td> </tr> <tr> <td>4</td> <td>SELECT * FROM building</td> <td>SELECT address FROM building</td> </tr> <tr> <td>5</td> <td>ALTER TABLE building ADD (value NUMBER (8));</td> <td>UPDATE building SET value = 100 000;</td> </tr> </tbody> </table>	#	SQL no1	SQL no2	1	DROP TABLE building;	DELETE FROM building;	2	INSERT INTO building VALUES (102, '45 Main Street, St-John', 'residential');	UPDATE building SET type= 'residential' WHERE id= 102	3	DELETE FROM building WHERE id = 102;	INSERT INTO building VALUES (102, '45 Main Street, St-John', 'residential');	4	SELECT * FROM building	SELECT address FROM building	5	ALTER TABLE building ADD (value NUMBER (8));	UPDATE building SET value = 100 000;	2 2 2 2 2	
#	SQL no1	SQL no2																			
1	DROP TABLE building;	DELETE FROM building;																			
2	INSERT INTO building VALUES (102, '45 Main Street, St-John', 'residential');	UPDATE building SET type= 'residential' WHERE id= 102																			
3	DELETE FROM building WHERE id = 102;	INSERT INTO building VALUES (102, '45 Main Street, St-John', 'residential');																			
4	SELECT * FROM building	SELECT address FROM building																			
5	ALTER TABLE building ADD (value NUMBER (8));	UPDATE building SET value = 100 000;																			
10.	<p>Land disputes can operate at any scale from the international to those between individual neighbours. At whatever scale, the dispute is likely to owe as much to the general nature of neighbourly relations as to actual problems relating to the land. Explain four situations for why land disputes may arise and how a land information system can be used to mitigate these disputes.</p>	2.5 2.5 2.5 2.5																			
11.	<p>Infrastructures like transportation, power, and pipeline networks which are characterized by a spatial embedding are known as spatial networks. The largely increasing amount of generated data about spatial networks can only be efficiently stored and analyzed in a spatial database system.</p> <p>Translate the spatial network below into a UML conceptual schema.</p> 	7.5																			
TOTAL		100																			