UNIVERSITY of RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY
SCHOOL OF ENGINEERING
DEPARTMENT OF
CIVIL, ENVIRONMENTAL AND GEOMATIC ENGINEERING

END OF SEMESTER IEXAMINATION -ACADEMIC YEAR 2024/2025

YEAR: 3 SEMESTER: I PROGRAMME(S): SGE

MODULE: SGE3164 GEOGRAPHICAL INFORMATION SYSTEM I

DATE: 14/01/2025 **TIME: 2hours**

MAXIMUM MARKS = 50

INSTRUCTIONS

1. This paper contains **FOUR (4)** questions.
2. **Answer THREE (3) Questions only:**
   Question ONE (1) from Section "A" is Compulsory and Answer any TWO (2) from Section "B"
3. Any written materials and Programmable calculators are NOT allowed.
4. Do not forget to write your Registration Number.
5. Write all your answers in the booklet provided
6. Do not write any answers on this questions paper.
7. **Start each question in a NEW page**

SECTION: A

Question: 1 **[20]**

a) What tab, under the Data Frame Properties allows us to choose a coordinate system for the map ? **[2]**

i. Grids
ii. Data frame
iii. Size and positions
iv. Coordinate System

b) Which tables give data unique characteristics ? **[2]**

i. Data
ii. Excel
iii. Raster
iv. Attribute

c) Which type of geodatabase can have multiple editor but only if they work on different parts of the data ? **[2]**

i. File Geodatabase
ii. Personal geodatabase
iii. Microsoft database
iv. Enterprise database

d) How does catalog views and treats multifile shapefiles ? **[2]**

i. No different than File Explorer
ii. Grouped together as a single file
iii. As individual parts of Shapefile
iv. Only the .shp is viewed or treated

e) Where do we adjust the size of the layout area and its orientation ? **[2]**

i. Export Map
ii. Print Preview
iii. Printer Property
iv. Page and Print Setup

f) In the "Export Map" window, what two settings adjust the quality of the output image? **[2]**

i. General and Format
ii. Resolution and Dots per inch (DPI)
iii. Resample ratio and image quality
iv. Output image quality and resolution

g) Which tool do we use to create a new file of a layer's data in a different format ? **[2]**

i. Draw
ii. Export Data
iii. Edit Features
iv. Advanced Editor

h) Which item does the "Export Data" window not ask us to provide ? **[2]**

i. Format
ii. Output Location
iii. Feature to Export
iv. Coordinate System

i) A two-way Relationship between data tables/relations is a **[2]**

i. Join
ii. Relate
iii. Union
iv. Representation

j) What kind of analysis creates a layer comprised of intersected or united data ? [2]

i. Overlay
ii. Network
iii. Attribute
iv. Proximity

SECTION: B

Question: 2

[15]

a) Analyze carefully the following relations/tables and answer related questions. [10]

Spatial data table

Feature ID	Geometry	Area (sq km)
1	Polygon ((34.7, -1. 3,))	2.5
2	Polygon ((34.8, -1. 4...))	1.2
3	Polygon ((34.6, -1.2, ...))	3.0

Attribute data table

Feature ID	Land Use	Population Density (per sq km)	Crime Rate (per 1000)
1	Residential	200	5
2	Residential	300	12
3	Commercial	[illegible]	N/A

Translate the following SQ Language to human language and print the result.

i.
```
SELECT Feature_ID, Geometry, Land_Use, Population_Density, Crime_Rate
FROM Spatial_Data
JOIN Attribute_Data ON Feature_ID = Feature_ID
WHERE Land_Use = 'Residential'
  AND Population_Density < 250
  AND Crime_Rate < 10;
```

ii.
```
SELECT Feature_ID, Geometry, Area, Land_Use, Population_Density
FROM Spatial_Data
JOIN Attribute_Data ON Feature_ID = Feature_ID
WHERE Area > 2
  AND Population_Density < 250;
```

a) Explain the components of Geographical Information System. [5]

Question: 3 **[15]**

a) Given the following raster datasets A and B

A

75	62	48	43	33
27	51	39	26	40
43	39	28	30	27
41	25	19	40	20
28	31	26	50	15

B

10	12	28	23	13
17	15	19	26	10
23	19	18	13	17
11	15	19	10	20
18	13	16	15	19

Print the output raster based on used operator:

i. C1=A+13 **[1.5]**

ii. C2=A+B **[1.5]**

iii. C3=((A-B)/(A+B)) *10 **[4]**

iv. C4= A < = 20 AND B = > 14 **[3]**

b) Briefly, explain the main steps to build the Database **[5]**

Question: 4 **[15]**

a) Given two sets A and B, and the logical operators which are used in Raster overlay analysis, you are asked to draw the output results' sets and explain the meaning of each operator. **[5]**

b) Given two raster layers A and B.

V	V	V		
V	V			
	V	V		V
		V	V	V
			V	V

Vegetation

V=Vegetation
8=800 meters
7=700 meters
6=600 meters
5=500 meters

8	8	8	8	5
8	8	8	8	5
7	5	5	5	7
7	7	5	5	5
7	7	7	7	7

Elevation

Follow the condition and print the output Raster **[10]**

O1: = (A ="Vegetation") AND (B<700)
O2: = (A ="Vegetation") OR (B<700)
O3: = (A ="Vegetation") XOR (B<700)
O4: = (A ="Vegetation") AND NOT (B<700)

UNIVERSITY of RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY
SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL, ENVIRONMENTAL AND GEOMATICS ENGINEERING

SGE3163 GIS I- CAT Two — *Date: 04th/12/2024*

YEAR III, SGE-SEM-I — *Duration: 1hour*

1) What are main types of data sources in GIS? */1mark*
2) Explain the sources of data for GIS */3marks*
3) Differentiate semi-automatic from automatic digitization? */2marks*
4) Explain the vectorization process and its limitations in digitization? */4marks*
5) Explain the data qualities to be checked for consistency and completeness during GIS data preparation. */3 marks*
6) List the seven reasons why to use a database management system. */3.5 marks*
7) Enumerate the seven main steps for database building. */3.5 marks*
8) Given the following relations: Private person, Parcel and Ownership. You are asked to print the output from the following SQL Statement:

SELECT: Surname, DeedNumber

FROM: Ownership, PrivatePerson

WHERE: Ownership.TaxId = PrivatePerson.TaxId AND Value <=550 */5marks*

Private person

Tax_id	Surname	Birth_date
A74-b	Emmy	12-4-1984
C66-b	Jack	04-9-2001
Q92-c	Joe	24-2-1995
B76-a	Smith	30-7-2005

Parcel

Pid	Land Use
28754	Glass land
59732	Urban
61120	Crop land
59743	Recreational land

Ownership

Pid	Tax_id	DeedNumber	Value
28754	A74-b	2000-01-76	300
59732	C66-b	2005-04-48	800
61120	Q92-c	1997-08-30	550
59743	B76-a	2006-06-15	1000

Good Luck!

UNIVERSITY of RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY
SCHOOL OF ENGINEERING
DEPARTMENT OF
CIVIL, ENVIRONMENTAL AND GEOMATIC ENGINEERING

END OF SEMESTER I EXAMINATION -ACADEMIC YEAR 2024/2025

YEAR: 3 SEMESTER: I PROGRAMME(S): SGE

MODULE: SGE3163 REMOTE SENSING II

DATE: 10/01/2025

TIME: 2hours

MAXIMUM MARKS = 50

INSTRUCTIONS

1. This paper contains **FOUR (4)** questions.
2. **Answer THREE (3) Questions only:**
   Question ONE (1) from Section "A" is Compulsory and Answer any TWO (2) from Section "B"
3. Any written materials and Programmable calculators are NOT allowed.
4. Do not forget to write your Registration Number.
5. Write all your answers in the booklet provided
6. Do not write any answers on this questions paper.
7. **Start each question in a NEW page**

SECTION: A

Question: 1

a) Which order of Polynomial equation is needed to have fifty-five ground control points in image transformation process? **[2]**

b) Filter operations are local image transformations. Given a small portion of 3x3 pixel of 16,17,21,14,10,16,3,8,13; compute the image gain. **[2]**

c) Explain why Maximum Likelihood Algorithm is the best classifier compared to box classifier, and minimum distance to mean classifier **[3]**

d) Tobler's first law of states that "everything is related to everything else, but near things are more related than distant." Look at the following portion of Landsat satellite image, and based on the Tobler's law and the distribution of Digital numbers' values, answer the following questions.

78	80	92	85	82	90	91	88	86	79
77	92	100	87	85	89	89	87	80	78
81	102	100	90	91	100	95	90	88	80
100	105	101	95	96	103	97	93	90	85
0	0	0	0	0	0	0	0	0	0
102	104	100	98	95	102	100	95	91	87
100	103	255	96	93	100	101	96	89	88
100	100	98	98	94	102	103	98	90	89

i. What are the two main errors are you finding in this image? **[2]**

ii. Are these errors systematic or random? **[2]**

iii. Explain briefly the cause of these errors. **[2]**

iv. Explain briefly effects of these errors. **[2]**

v. Explain the correction methods for these errors. **[2]**

vi. Apply these correction methods and print the corrected output image. **[3]**

SECTION: B

Question: 2

The following 5x5 input images of Landsat satellite represent the two neighboring area, but were taken under different solar illuminations (winter and summer) with the solar elevation angle of 60 degrees.

Input image A

100	103	98	88	76
97	98	100	101	82
99	100	105	107	89
102	98	100	104	95
97	98	99	100	98

Input image B

105	110	100	90	82
100	102	108	110	92
106	109	112	120	98
118	110	118	115	106
111	113	115	120	118

a) Which correction do you need before performing mosaicking of these images? **[2]**

b) If these images are 8 bits, which one of them has high radiometric resolution, and why? **[5]**

c) Apply the appropriate formula and print the corrected output images A' and B' from input A and B respectively. **[8]**

Question: 3

a) In Deep/Machine learning, filter operations are local image transformations applied to single band of satellite image.

45	50	53	42	40	49	30	54	70	74
38	42	50	39	33	46	37	57	63	76
51	60	55	45	40	51	41	60	65	80
61	65	60	50	42	40	39	54	60	75
70	72	68	55	45	50	40	50	65	70
74	77	70	60	50	55	46	60	50	65
80	70	64	65	46	40	50	56	60	70
74	63	70	69	51	47	60	55	67	73
88	66	75	64	49	40	56	43	60	63
83	70	69	60	55	43	50	40	58	60

*

1	0	1
2	3	1
1	0	2

i. Use the given Kernel to perform the filter operation by striding method and print output image **[5]**

ii. To avoid the issue of missing edges during striding method, apply Padding method and print the output image. **[5]**
The output image size should meet this condition: $(n * f) = (n - f + 1) * (n - f + 1)$
where, n is the size of input image, and f is the size of the filter.

b) Given SPOT XS multispectral image with 25-meter pixels, and SPOT panchromatic image with 5-meter pixels, you are asked to apply the image fusion of both SPT XS and SPOT. Explain the required processes to fuse these images and give the end results. **[5]**

Question: 4

a) A remote sensing satellite captures an image of Gishwati national park. Propose a step-by-step method for identifying areas affected by deforestation. **[5]**

b) After performing the image classification, the confusion matrix has been produced to test the classification accuracy as indicated by the following table.

	A	B	C	D	Total	Error of commission	User Accuracy
a	35	15	31	2	83		
b	4	12	4	0	20		
c	13	10	38	4	65		
d	3	4	11	2	20		
Total	55	41	84	8	188		
Error of omission							
Producer accuracy							
Overall accuracy							

Given four reference classes A, B, C and D, and their corresponding classified classes a, b, c, and d; you are asked to fill the above table after computing the following:

i. Error of commission. **[2]**
ii. Error of omission. **[2]**
iii. User accuracy. **[2]**
iv. Producer accuracy. **[2]**
v. Overall accuracy. **[2]**

The purpose of Image fusion is in order to achieve satisfaction

UNIVERSITY of RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY
SCHOOL OF ENGINEERING
DEPARTMENT OF
CIVIL, ENVIRONMENTAL AND GEOMATIC ENGINEERING

END OF SEMESTER I EXAMINATION -ACADEMIC YEAR 2024-2025

YEAR: 3 SEMESTER: I PROGRAMME(S): SGE

MODULE CODE & TITLE: SGE3162 GNSS FOR GEPMATICS I

DATE: 08/01/2025 **TIME: 2hours**

MAXIMUM MARKS = 50

INSTRUCTIONS

1. This paper contains **FOUR (4)** questions.
2. **Answer THREE (3) Questions only:**
   Question ONE (1) from Section "A" is Compulsory and Answer any TWO (2) from Section "B"
3. Any written materials and Programmable calculators are NOT allowed.
4. Do not forget to write your Registration Number.
5. Write all your answers in the booklet provided
6. Do not write any answers on this questions paper.
7. **Start each question in a NEW page**

SECTION: A

Question: 1 **[20]**

a. Write short notes on the following terms used in Global Navigation Satellite System. **[3]**

i. Satellite constellation

ii. Precise Point Positioning

iii. Selective Availability

b. What is the difference between a "geostationary satellite" and a "non-geostationary satellite"? **[2]**

c. A signal takes **12 ms** to travel from a satellite to a user on Earth. Given that the speed of light is approximately **3×10^8 meters per second**, determine the distance between the satellite and the user. **[3]**

d. What is the purpose of SBAS? State free Satellite Based Augmentation System services are available around the world? **[4]**

e. Each satellites travel on its on orbit. What are the characteristics of GPS orbit? **[4]**

f. Discuss Global Navigation Satellite System Surveying techniques. **[4]**

SECTION: B

Question: 2 **[15]**

a. What role does GNSS play in autonomous vehicles and limitations? **[4]**

b. Examine the various applications of GNSS in the field of transportation (aviation, maritime, and road traffic). How does GNSS enhance safety and efficiency in these sectors? **[5]**

c. GPS space segment modernization has included new signals. Describe GPS new navigation signals. **[6]**

Question: 3 **[15]**

UNIVERSITY of RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING

DEPARTMENT OF

CIVIL, ENVIRONMENTAL AND GEOMATIC ENGINEERING

END OF SEMESTER I EXAMINATION -ACADEMIC YEAR 2024-2025

YEAR: 3 **SEMESTER: I** **PROGRAMME(S): SGE**

MODULE: SGE3165 CADASTRE AND LAND ADMINISTRATION II

DATE: 17/01/2025

TIME: 2hours

MAXIMUM MARKS = 50

INSTRUCTIONS

1. This paper contains **FOUR (4)** questions.
2. **Answer THREE (3) Questions only:**
   Question ONE (1) from Section "A" is Compulsory and Answer any TWO (2) from Section "B"
3. Any written materials and Programmable calculators are NOT allowed.
4. Do not forget to write your Registration Number.
5. Write all your answers in the booklet provided
6. Do not write any answers on this questions paper.
7. **Start each question in a NEW page**

SECTION: A

[20]

Question: 1

a) Referring to the general principles for land boundary re-establishment, the re-established boundary should follow the intention of the title plan; otherwise, the existence of any significant discrepancies should be justified with proper reasons. With respect to this concept, answer the follow questions:

i) Explain the reasons why certified land surveyors in Rwanda, even though they do the re-establishment carefully with the help of calibrated DGPSs of high accuracy, correctly set out and sufficiently receiving enough satellite signals, they sometimes observe significant discrepancies between their re-established boundaries and the boundaries shown on the title plans that were prepared during systematic land registration. **[5]**

ii) Assuming that you are a certified land surveyor and you are given the task to undertake land boundary re-establishment and you encounter the same problem as the one mentioned in question 1, a (i) above; what are your possible inputs and advices to the land owners for such problem to be resolved? **[5]**

b) The process of international boundary making is generally undertaken into five main stages. As a person who learnt the module of Cadastre and Land Administration II, discuss about the first three of steps. **[6]**

c) When undertaking boundary survey operation, you need to perform different stages among which include land search and field reconnaissance. Explain how the two stages differ from each other. **[4]**

SECTION: B

[15]

Question: 2

a) Given the corners' coordinates of a land parcel in table 1 below, calculate the area of the parcel using Shoelace method.

ID	X (m)	Y (m)
1	503784.784	4810836.405
2	503774.450	4810866.759
3	503776.247	4810867.753
4	503788.213	4810872.377
5	503801.164	4810842.543

Table 1: Land parcul's corners' coordinates [8]

5) Assuming that in the triangle shaped land parcel ABC, the coordinates (E_A,N_A) of point A and (E_B,N_B) of point B as well as the bearing "α" of the line AC and bearing "β" of the line BC are known, demonstrate the formula of computing the unknown coordinates (E_C,N_C) of point C. Given figure 1 below. [7]

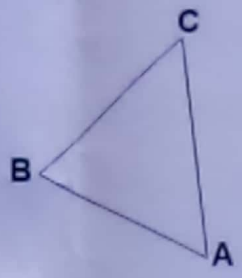

Figure 1: A triangle shaped land parcel

Question: 3 **[15]**

a) When it comes to preparing for negotiation during the process of making boundary between neighbouring countries, some issues deserve a particular attention at National level and at bilateral level. Talk about **three issues** to take into account when the highest national political Authority is internally discussing on preparation of boundary that separates it from its neighbouring country. **[6]**

b) Under UNCLOS, a coastal State may gain the right to explore and exploit resources in the seabed and subsoil of the extended continental shelf, beyond 200 nautical miles from its coast. However, the water column above the extended shelf remains part of the high seas. In the context of the UNCLOS, explain the concept behind this statement. **[6]**

c) What UNCLOS stands for and what are its aims? **[3]**

Question: 4 **[15]**

a) In the process of boundary dispute resolution, it is necessary to search for boundary evidences and they are categorised into **three categories**. Differentiate those categories of boundary evidences. **[6]**

b) Monumentation for boundary identification requires the use of good boundary monuments. As a land surveyor, discuss about at least **three characteristics** of a good boundary monument (survey mark) **[6]**

c) Explain at least **three key areas** where cadastral data is applied in Rwanda. **[3]**

END