UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: May 2023

Module Number: CE5252   **Module Name: Remote Sensing and GIS (C-18)**

[Three Hours]

[Answer all questions. Each question carries **TWELVE** marks]
All Standard Notations denote their regular meanings

Q1.   Aerial photographs are a easy and quick way to collect data.

a) Define what is a vertical- aerial and oblique-aerial and terrestrial photographs giving one use of them.

[1.0 Marks]

b) Determine the required flying height of the airplane above the average ground elevation in order to meet the requirement of capturing photos at a scale of 1:10,000. Assume a camera with a focal length of 100 mm mounted on the airplane, and terrain elevation of 200 meters above mean sea level (AMSL).

[2.0 Marks]

c) In the vertical photo described in Q1. b), there is an image of a tower captured. The top and bottom of the tower in the image is positioned 78 mm and 70 mm away from the plumb point respectively. Calculate the height of the tower.

[3.0 Marks]

d) During the same aerial photo session, the plane had to adjust its flying height due to an unavoidable situation. However, the specific flying height was not recorded. The photo coordinates of images a and b of ground points A and B in such a vertical photograph are given in Table Q1-1. If the horizontal distance between A and B is later measured and found to be as 3,250 m, and the elevations of A and B above the datum are 132 m and 176 m, respectively. Determine the flying height of plane above the datum.

[3.0 Marks]

e) If the plane is having a heading of 97° (parallel to x axis of photo), determine the whole circle bearing of the line AB

[3.0 Marks]

Q2. a) Define the following with aid of neat sketches
    i.   Declination of a star
    ii.   First point of Aries
    iii.   Right accessions of a star

[3.0 Marks]

b) The Sun was observed at station (A) having a latitude of 07°29′19″ N at 15 hr 13 min (Sri Lanka Standard Time UT+5:30) in order to determine the WCB of a survey line. Corrected altitude of the Sun is 22°32′34″. Other observations are shown in Table Q2-1. Declination of the Sun on the day of observation is 12° 25′ 6″ N at 00h UT and decreasing at 59″ per hour.) Determine the following.
    i.   UT at observation

[1.0 Marks]

    ii.   Declination of the Sun at the time of observation.

[1.0 Marks]

    iii.   Bearing of the Sun.

[5.0 Marks]

    iv.   Mean horizontal angle between B and the Sun.

[1.0 Marks]

    v.   The bearing of Line AB.

[1.0 Marks]

Q3. a) Define the following terms related to Earth.
    i.   International date line
    ii.   Co-latitude
    iii.   Greenwich hour angle
    iv.   Local hour angle

[4.0 Marks]

b) Bangkok airport offers flights by Singapore Airlines to Katunayake airport and by Sri Lankan Airlines to Mattala airport. There are two options to reach Galle: flying to Katunayake and taking a taxi, or flying to Mattala and taking a taxi. Determine the fastest travel option.

- Departure times
  - Singapore Airline flight: 09:00 hrs
  - Sri Lankan airline flight: 10:00 hrs
- Land travel time in taxi to Galle from
  - Katunayake airport: 03:00 hrs
  - Mattala airport: 04:00 hrs
- Location
  - Mattala: 06.1238° N,   081.1205° E
  - Bangkok: 13.7279° N,   100.5241° E
  - Katunayake: 07.1729° N,   079.8849° E
- Average air speed aircraft
  - Singapore: 800 km/hr
  - Sri Lankan: 750 km/hr
- Radius of Earth: 6371 km
- Customs and immigration delays are the same at both airports

[8.0 Marks]

Q4. a) Compare and contrast the geoid and the ellipsoid.

[2.0 Marks]

b) Briefly describe the three segments of GNSS.

[3.0 Marks]

c) Briefly explain the static GNSS survey method which is used determine the locations of control stations.

[3.0 Marks]

d) Briefly explain "raster" and "vector" data in a GIS database with aid of neat sketches.

[2.0 Marks]

e) What is meant by "Spatial data" and "Attributes of data" in GIS?

[2.0 Marks]

Q5. a) With the aid of sketches, list and describe all relevant parts of an active remote sensing system.

[2.0 Marks]

b) Define the following terms with respect to remote sensing.
     i.   Rayleigh scattering
     ii.   Mie scattering
     iii. Atmospheric windows
     iv.   Sun Synchronous satellite

[4.0 Marks]

c) The local government body faces a significant issue in terms of insufficient information regarding the specific types of crops being cultivated, their overall condition, and the scale of their production. This lack of data hinders the proper assessment of taxes related to agricultural activities. Explain how remote sensing can be applied to solve this issue.

[4.0 Marks]

d) List four applications of remote sensing other than the applications mentioned in Q5. c).

[2.0 Marks]

Equations, Figures and Tables

Table Q1-1

Point	x mm	y mm
a	35.0	68.0
b	-40.0	75.0

Table Q2-1 TS readings taken to Sun

Object	Face	Horizontal Circle
Point B	R	60° 00' 00"
Sun center	R	191° 38' 00"
Sun center	L	12° 39' 30"
Point B	L	240° 00' 00"

$$L = \frac{\lambda \delta \phi}{\cos\left(\alpha_m + \frac{\delta \alpha}{2}\right)}$$

$$\varphi_m = \frac{\varphi_A + \varphi_B}{2}$$

$$r = -58 \cot(H_O)$$

$$\alpha_m = \tan^{-1}\left(\left[\frac{\mu \Delta L}{\lambda \delta \phi}\right]\right)$$

$$\delta \alpha = \Delta L \sin(\varphi_m)$$

$$H = H_o + r$$

$$GSrT = RA - \lambda_E$$

$$\cos A = \frac{\cos a - \cos(b) \times \cos(c)}{\sin(b) \times \sin(c)}$$

$$BC^2 = AB^2 + AC^2 - 2AB \times AC \cos A$$

$$Sin(A + B) = Sin(A)Cos(B) + Cos(A)Sin(B)$$

$$NDWI = \frac{Green - NIR}{Green + NIR}$$

$$NDMI = \frac{Red - NIR}{Red + NIR}$$