



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: August/September 2014

Module Number: CE5233

Module Name: Advanced Surveying

[Three Hours]

[Answer all questions, each question carries twelve marks]

Q1. a) Explain the following terms used in positional astronomy.

- i) Local mean time
- ii) Local sidereal time
- iii) Hour angle

[3.0 Marks]

b) Raja, standing in front of the admin building, at the Hapugala Engineering faculty on 20th October 2014 decided to check the accuracy of his watch by making a star observation. He observed Sirius when it crossed the local meridian and the time according to his watch was 8:41 pm.

- i) Was Raja's watch accurate?
- ii) If not what was the error?

Right ascension of Sirius – 6h 45m

Local sidereal time at Hapugala at noon of 01st Oct. 2014 – 14h 3m

[9.0 Marks]

Q2 a) "Electromagnetic Distance Measurement (EDM) technique is much better compared to traditional distance measuring techniques in engineering surveying". Rationalize this expression.

[2.0 Marks]

b) What is meant by wave "Modulation" in EDM? With simple sketches briefly explain the difference between amplitude and frequency modulation.

[2.0 Marks]

c) Two Electromagnetic waves with wave length of λ_1 and λ_2 meters ($\lambda_1 < \lambda_2$) were sent from an EDM instrument. After being refracted from a prism refractor at a distance D the two waves recorded phase shifts of ϕ_1 and ϕ_2 respectively. It can be shown that when $\phi_1 > \phi_2$ number of full cycles made by the two waves are equal ($n_1 = n_2$). For such a situation ($\phi_1 > \phi_2$), derive an equation for distance D in terms of λ_1 , λ_2 , ϕ_1 , and ϕ_2 . Hence, find the equation to determine Maximum Distance, D.

[4.0 Marks]

d) Modern EDM instruments use phase differences of electromagnetic waves with several wavelengths of different frequencies to measure distance between two points. Table Q2 shows the data for three waves used in an EDM for such a measurement between point A and B (<1000 m).

i) Calculate the round trip phase difference ($\Delta \lambda$ in meters) for 3 waves.

[1.5 Marks]

ii) Hence calculate the distance between points A and B.

[1.5 Marks]

e) In determination of zero constant error for an EDM instrument calibration, following measurements were taken along XYZ line as in Figure Q2; XY= 12.003m, YZ= 20.003m and XZ= 32.000m. What is the zero constant error for this instrument?

[1.0 Marks]

Q3 a) What distance does an electromagnetic wave travel through the atmosphere within 0.0025 milliseconds? Velocity of electromagnetic energy in a vacuum = 299,792,458 m/s. Assume that actual index of refraction for this atmosphere is 1.0004.

[1.5 Marks]

b) If an EDM has a standard error of $\pm (2\text{mm} + 2\text{ppm})$, what would be the expected error in measuring a 750 m line?

[1.5 Marks]

c) Briefly describe about cyclic errors and scale errors, which may occur in EDM instruments.

[2.0 Marks]

d) "Geographic Information Systems (GIS) is sometimes considered as strictly a mapping function. However, GIS should be much more than a Map". Rationalize this idea.

[2.5 Marks]

e) What is meant by DBMS in GIS?

[2.0 Marks]

f) State the advantages and limitations of satellite remote sensing over other methods of data collection.

[2.5 Marks]

Q4. a) Hardware system is one of the components of a GIS.

i) Discuss briefly Hardware as one component of GIS.

[2.0 Marks]

ii) List out other key component of a GIS.

[1.0 Marks]

b) What is meant by Raster data and Vector data in GIS? List the advantages and disadvantages of Raster data and Vector data.

[3.0 Marks]

c) Figure Q4 (i) shows a graphical representation of a part of one community. Using two separate annotated sketches, show how you may represent these real world features in a vector data model and a raster data model.

[2.0 Marks]

d) Assume that you are a planning engineer of a project of waste water collection, treatment and disposal system for a newly developed city shown in Figure Q4 (ii). Your objectives are to plan the waste water collection network and to locate the wastewater treatment plant (WWTP). Consider following facts into your plan.

- Only houses lie within 100m from the main streets (both sides) will be connected to the sewer network while others will have their own septic tank systems.
- WWTP should be located at least 500m away from the flood hazard areas.

- Treated effluent will be discharged to the downstream of the river.

Briefly explain how you can use GIS technology to achieve above objectives with by answering following.

- Clearly mention about data and nature of GIS data you may use and how you may integrate those data in the GIS to achieve your objectives. It is not necessary to mention about particular GIS software and only explain about common GIS facilities which can be used to plan this project.
- Write down any assumption you made to build up your answer.

[4.0 Marks]

Q5 a) Define the following terms in satellite remote sensing.

- i) Spectral resolution
- ii) Spatial resolution

[2.0 Marks]

b) Explain the following, with respect to the type of energy sources use in satellite remote sensing.

- i) Passive remote sensing
- ii) Active remote sensing

[3.0 Marks]

c) i) What is meant by a sun-synchronous satellite orbit?
ii) What are the advantages and the disadvantages of such an orbit?
iii) List some of its application areas.

[4.0 Marks]

d) Visible spectral region and Near-Infrared spectral region are used extensively in remote sensing applications. Describe the above statement giving examples.

[3.0 Marks]

Table Q2: Data for three waves used in an EDM

Wave Length, λ	Measured Phase Shift Angle for Round-trip distance Phase Difference, Φ (Degree)
10 m	51°
100 m	221°
1000 m	238°



Figure Q2: XYZ line

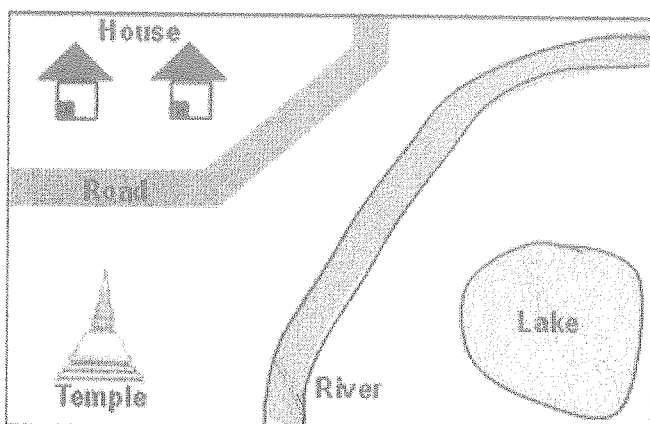


Figure Q4 (i) : Graphical representation of a part of one community

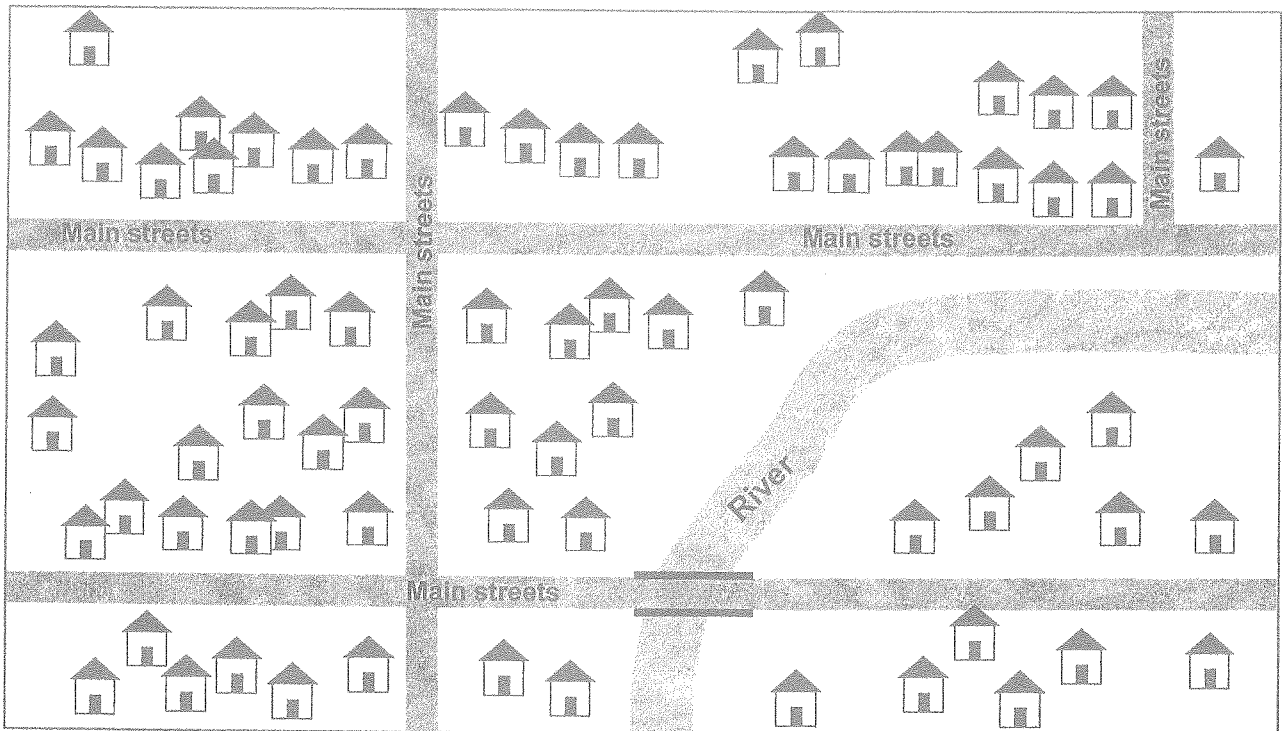


Figure Q4 (ii) : A newly developed city to plan a waste water collection, treatment and disposal system