UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: July 2016

Module Number: CE5255 **Module Name: Remote Sensing and GIS**

[Three Hours]

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

Q1. a) With the aid of neat sketch, derive the Cosine rule for a spherical triangle. You may start from Cosine rule for a plane triangle.

[2.0 Marks]

b) A new high speed undersea internet cable connection is proposed for The Andaman Islands (11° 35′ 46″ N, 92° 36′ 45″ E). Chennai city (12° 47′ 24″ N, 80° 15′ 02″ E) in India and Batticaloa town (7° 55′ 27″ N, 81° 33′ 31″ E) in Sri Lanka are the two proposed starting points. Cable is to be laid along the shortest path. Assuming that the sea bed is flat and the radius of Earth to be 6,371 km, determine the following:

i. Length of the cable from Chennai city

[1.5 Marks]

ii. Length of the cable from Batticaloa town

[1.5 Marks]

c) A long survey is measured between two points "A" and "B" (for details see Table Q1-1) both situated in the northern hemisphere. Using the Earth curvature data given in Table Q1-2, determine the following:

i. Mean latitude (φ_m)

[1.0 Mark]

ii. Correction due to convergence of meridians ($\delta\alpha$)

[1.0 Mark]

iii. Length of the 1″arc of latitude (λ) at mean latitude.

[1.0 Mark]

iv. Length of the 1″arc of longitude (μ) at mean latitude.

[1.0 Mark]

v. Forward bearing (α_{AB})

[1.0 Mark]

vi. Reverse bearing (α_{BA})

[1.0 Mark]

vii. Length of the line (L_{AB})

[1.0 Mark]

Q2. a) A star was observed at the northern sky of Hapugala (6° 04′ 52″ N, 80° 11′ 27″ E) when the star was crossing the meridian. Observed altitude was 67° 28′ 25″ and the Greenwich sidereal time at the moment of observation was $0^{hrs}\ 5^{min}\ 31.2^{sec}$. Answer the following using the data given above.

i. Construct the semicircle with the diameter as the north south plane of the observation and indicate the position of the star, zenith, and pole with relevant values.

[1.0 Mark]

ii. Determine the corrected altitude of the star.

[1.0 Mark]

iii. Determine the declination of the star.

[2.0 Marks]

iv. Determine the right accession (RA*) of the star.

[2.0 Marks]

v. Identify the star using the star maps given in Figure Q2-1 and Figure Q2-2.

[1.0 Mark]

b) Details of zenith pair observations at location in the northern hemisphere are shown in Table Q2-1.

i. Determine the average latitude of the observer.

[3.0 Marks]

ii. What is the local sidereal time when star 1 crossing the local meridian 85° 21′ 15″ E?

[1.0 Mark]

iii. What is the Greenwich sidereal time when star 2 is crossing the local meridian 85° 21′ 15″ E?

[1.0 Mark]

Q3. A phototheodolite having a focal length of 200 mm was used at two stations "A" and "B" having co-ordinates (0,0) and (0, 152.242) m respectively. In both cases station "C", a tower 47.5 m high to the north, is on the vertical centre line of the photograph. In that from "A" it measures 26.00 mm and its base is 6.50 mm above centre, while in that from "B" it measures 24.00 mm and its base is 1.00 mm above the centre (See Figure Q3-1).

a) Determine the co-ordinates of "C".

[3.0 Marks]

b) Determine the level of the tower base relative to "B".

[2.0 Marks]

c) Determine the directions (WCB) of the sights of the phototheodolite from "A" and "B".

[2.0 Marks]

d) Determine the level difference between "A" and "B".

[2.0 Marks]

e) A point "D" located 16.20 mm right and 17.60 mm up in the photograph from "B", if it is in line with the tower as seen from "A". Would it be visible from "A"?

[3.0 Marks]

Q4. a) With neat sketches explain how remote sensing can be applied to "Tax Mapping".

[3. 0 Marks]

b) During annual tax collection process one farmer complained that he is not in a position to pay tax as the Irrigation Department failed to supply adequate amount of water to his crops. Assuming that remote sensing data is available for the farm area for the entire area with reasonable temporal resolution. Explain how you can verify this claim based on remote sensing data.

[2. 0 Marks]

c) Define the following terms in terms of remote sensing

i. Active remote sensing
ii. Spectral signature
iii. Atmospheric window
iv. Temporal resolution

[4.0 Marks]

d) List six applications of remote sensing other than the applications mentioned in Q4. a) and b).

[3.0 Marks]

Q5. a) Traditionally GPS is divided into three segments. Briefly explain them.

[1.5 Marks]

b) Explain the principle of Differential GPS as required for high standards of accuracy on a surveying site.

[2.5 Marks]

c) State the main reason how the use of GPS for surveying has overcome the site problems associated with

i. Triangulation
ii. Traversing.

[2.0 Marks]

d) With neat sketches, explain the static and kinematic GPS surveying methods.

[3.0 Marks]

e) Briefly explain the difference between GPS and GIS.

[3.0 Marks]

Figures and Tables

Table Q1-1: Point Coordinate Data

Point	Latitude	Longitude
A	52° 20′ 20″	88° 20′ 15″
B	52° 24′ 25″	88° 29′ 20″

Table Q1-2: Earth Curvature Data

At Altitude	Length of 1" of Latitude (m)	Length of 1" of Longitude (m)
52° 20′ 00″	30.91022	18.93637
52° 25′ 00″	30.91065	18.90077

Table Q2-1: Zenith Pair Observations

Star	Declination	RA	Observed Altitude
1	S 15° 59′ 50″	$14^{hr}\ 50^{min}\ 41^{sec}$	50° 20′ 20″
2	S 40° 23′ 26″	$15^{hr}\ 01^{min}\ 57^{sec}$	47° 34′ 20″

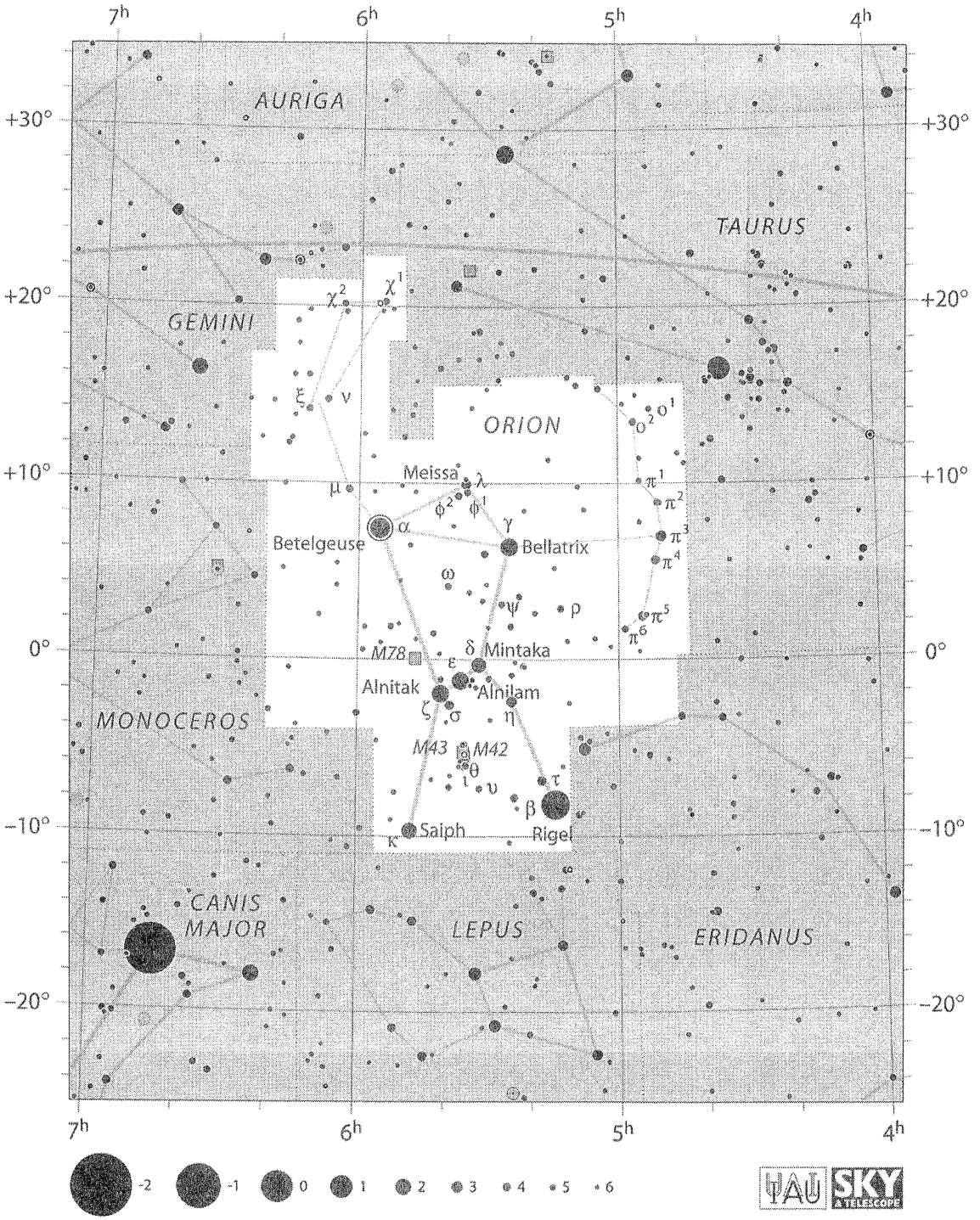

Figure Q2-1 Star Map of Orion Constellation

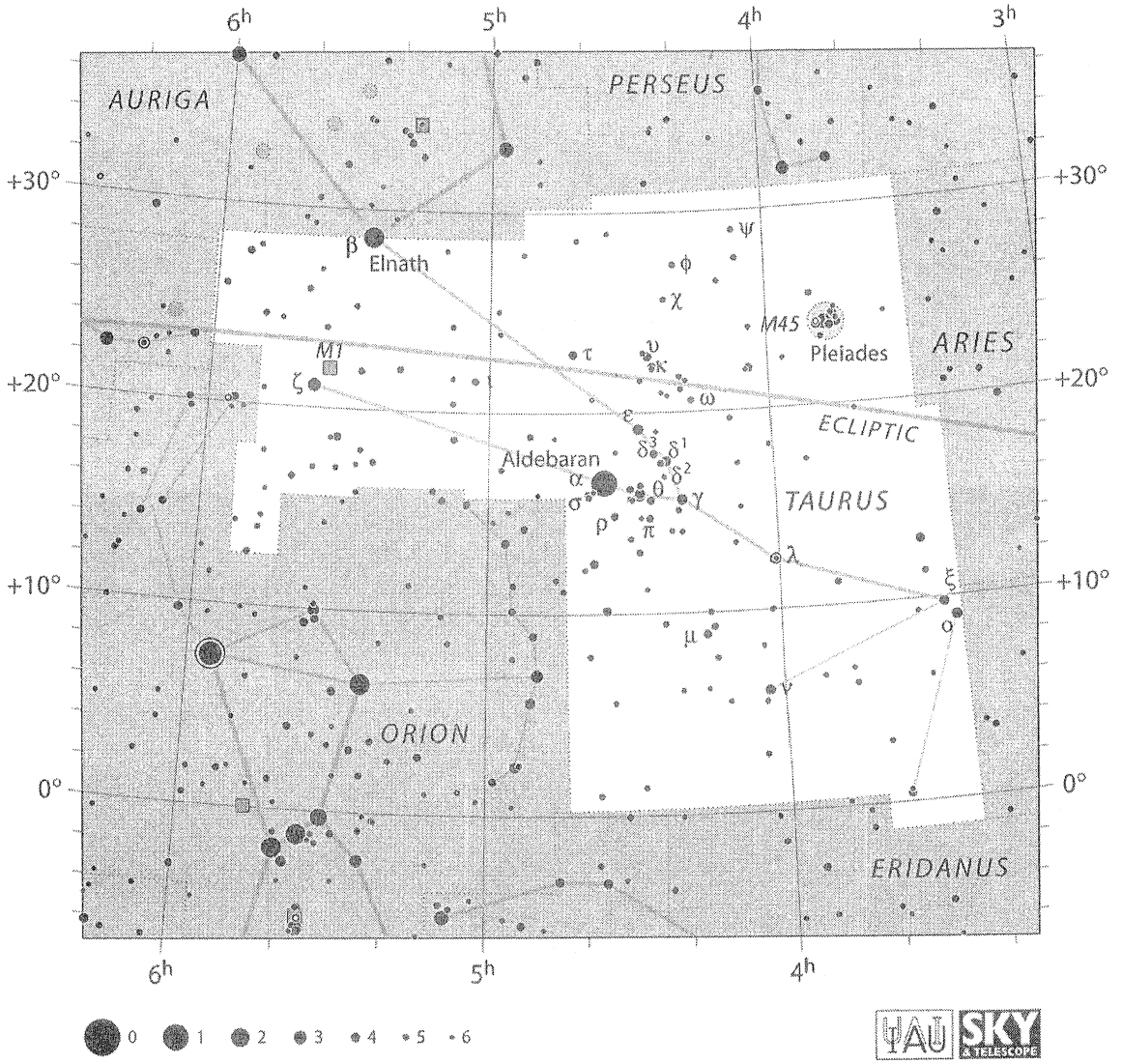

Figure Q2-2 Star Map of Taurus Constellation

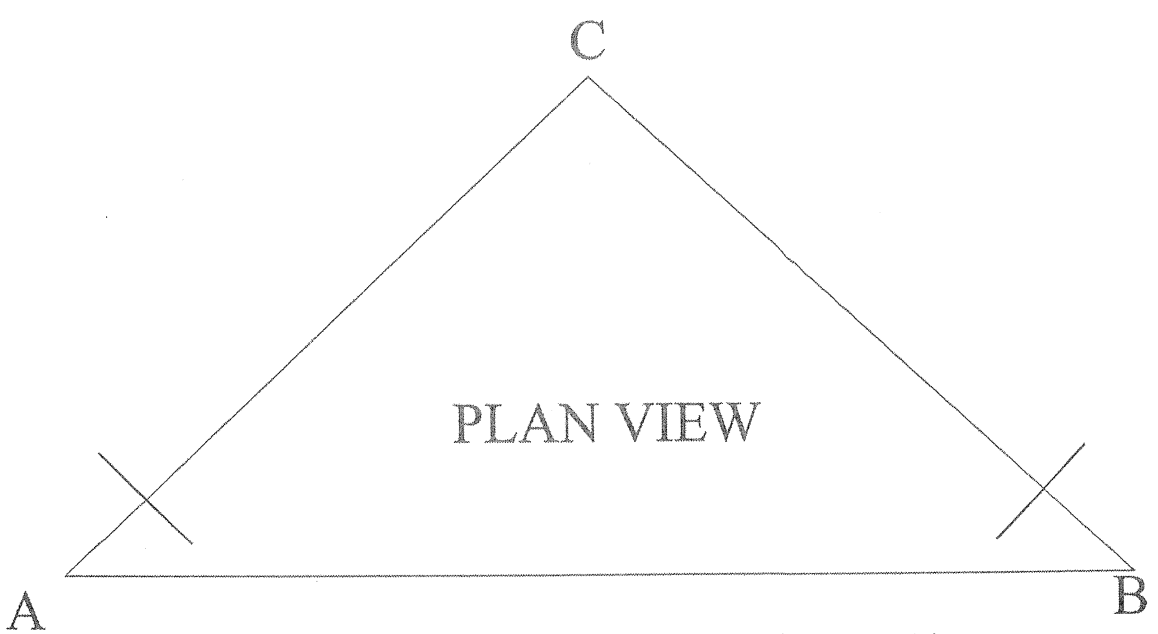

Figure Q3-1 Plan View of the Survey Area (not to scale)

Equations

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

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

$$r = -58\cot H_O$$

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

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

$$H = H_o + r$$

$$GSrT = RA - \lambda_E$$

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

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