

UNIVERSITY OF SOUTH AUSTRALIA

FACULTY OF ENGINEERING AND THE ENVIRONMENT

School of Geoinformatics, Planning and Building

Semester 1, 1999

Geodetic Concepts : 10233

Time Allowed : 3 hours + 10 minutes reading time

GENERAL INSTRUCTIONS TO CANDIDATES :

Total Marks = 100

This is an open book examination

Attempt four (4) questions from Part A and **all** questions from Part B.

Answer Part A and Part B in separate examination booklets

Part A equals **50%** and Part B equals **50%**. Marks for questions shown in brackets.

Please ensure front of answer books are completed with your name, student I.D. number, course and section of the examination (if applicable).

PART A

QUESTION 1

- (a) Describe the differences and relationships between the following surfaces :
- Mean sea level
 - Geoid
 - Sphere
 - Ellipsoid
- (b) Describe the differences in computational procedures for spherical and ellipsoidal datums for the following calculations :
1. The distance from the equator along a line of longitude to a point of given latitude
 2. Given the geodetic latitude and longitude of two points the distance between them
 3. The distance along a parallel of latitude between two point of given longitude.
- (12.5)**

QUESTION 2

- (a) In respect to the ellipsoid of revolution, discuss the meaning of the term “curvature of a normal section”.
- (b) Compute (to the nearest mm) the ellipsoidal radius of curvature for normal section passing through a point that has the following geodetic coordinates :

Latitude	$34^{\circ} 26' 56.367''$ South
Longitude	$138^{\circ} 24' 09.982''$ West

Datum	AGD 84
Azimuth of normal section	$214^{\circ} 34' 22.765'$

(12.5)

QUESTION 3.

Using map projection terms define the following map projections, describe their useful geographic extents and their mapping properties :

1. Stereographic projection centred at 0° E, 56° N
2. Polar Orthographic projection centred at the North Pole.
3. Transverse Mercator projection with a central meridian at 60° E
4. Universal Transverse Mercator projection with a central meridian at 60° E
5. Lambert conformal conic with standard parallels at 65° N and 85° N and a central meridian at 70° W.

(12.5)

QUESTION 4

Given the plethora and complexity of map projections and earth datums, surely it would be easier for all persons dealing with data about Earth to use a single three dimensional coordinate system based on the same mathematical datum.

Discuss the above statement

(12.5)

QUESTION 5

- (a) Without giving a mathematical derivation, describe the construction of the Transverse Mercator projection.
- (b) Compute the Universal Transverse Mercator zone number, the corresponding central meridian and false origin information which relate to the following points :

	Latitude	Longitude
i)	-56° 00' 39" 6	+100° 15' 17" 13
ii)	+22° 09' 10" 6	-179° 21' 33" 76

- (c) Briefly describe reasons for an organisation, which produces digital map products for a region the size of Malaysia, for preferring to use a map projection such as the Lambert Conformal Conic in preference to the Universal Transverse Mercator projection.

(12.5)

PART B

QUESTION 1

- (a) Discuss the difference between a local geodetic datum and a geocentric datum. Give an example of each.
- (b) A survey mark near Adelaide has an ellipsoidal height of 117.24 metres relative to the GDA94 datum. The geoid-spheroid separation (GDA94) at that point is +9.27 metres. What is the height of the point above sea level?
- (c) Continental drift is causing the Australian continent to move north-east at a rate of approximately 7cm per year. What impact will this have on the GDA94 coordinate system? Why?

[6]

QUESTION 2

You have been given AMG coordinates, the height above sea level, and the geoid-spheroid separation (relative to AGD66) for a survey mark. You are required to transform the coordinates and height into latitude, longitude and ellipsoidal height relative to the GDA94 datum. An accuracy of approximately 1 metre is required.

Clearly identify each of the steps in the transformations process.

[6]

QUESTION 3

- (a) What is meant by the term 'Grid Convergence'?
- (b) A line is measured between points A and B (coordinates below). Draw a diagram illustrating the representation of the line on a UTM map projection, labelling (Do not calculate these quantities)
- the projected spheroidal distance
 - the plane distance
 - the T-t corrections
 - the azimuth angle from A to B
 - the grid bearing angle from A to B
 - the Grid Convergence angle.

Point A	E 275,197.232 m	N 6,235,992.232 m
Point B	E 287,243.112 m	N 6,259,712.746 m

- (c) Why is a central scale factor of 0.9996 applied to all projected distances on the UTM grid?

[10]

QUESTION 4

- (a) Discuss the theory of GPS single point positioning using pseudorangeing (0.5 page)
- (c) Briefly discuss the difference between static, rapid-static, stop-and-go and real-time-kinematic GPS. Under what circumstances might each technique be used ?

[10]

QUESTION 5

Fred the fisherman is frustrated! Two weeks ago he purchased a single hand held GPS receiver to help him locate his favourite fishing spots. He understood GPS to be a very accurate positioning system. Yet even when he is stationary, the displayed coordinate values are constantly changing, sometimes by as much as 100 metres. When he compares the coordinate values with those on his map, they appear to be 200 metres in error on average. Fred is on the point of asking for a refund!

- (a) Explain to Fred the about error sources that affect GPS measurements and their likely impact on accuracy (0.5 page).
- (b) Explain the theory of differential GPS to Fred, and the impact that it will have on his position determinations (0.5 page).
- (c) Fred's map is 20 years old. What is the probable cause of the apparent difference between the GPS coordinates and the map coordinates for each feature? Explain what Fred must do to remedy this problem? Would the same problem be evident if Fred was using a map based on GDA94? Why?

[12]

QUESTION 6

- (a) Define the terms:
- normal section
 - geodesic
- (b) You have been given the latitude and longitude of two points 500 Km apart. You have been requested to manually compute the azimuths and distance between the two points. A precise result is required. It has been suggested that you should use the Gauss Mid-Latitude formulae for the task. Do you agree or disagree with this suggestion (give reasons)? If you disagree, recommend an alternative approach.

[6]