UNIVERSITY OF SOUTH AUSTRALIA

FACULTY OF ENGINEERING AND THE ENVIRONMENT

School of Geoinformatics, Planning and Building

Semester 1, 2001

Geodetic Concepts : 10233

Time Allowed : 3 hours + 10 minutes reading time

GENERAL INSTRUCTIONS TO CANDIDATES:

Total Marks = 100

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

Part A equals 52% and Part B equals 48%. Marks for questions are shown in brackets.

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

ABBREVIATIONS AND CONSTANTS USED IN THIS EXAM

AGD84 – Australian Geodetic Datum 1984
Semi major axis 6378160 metres
Flattening 1 : 298.25
WGS84 – World Geodetic System 1984
Semi major axis 6378137 metres
Flattening 1 : 298.257223563
GDA94 – Geodetic Datum of Australia 1994
Semi major axis 6378137 metres
Flattening 1 : 298. 257222101
UTM – Universal Transverse Mercator
GPS – Global Positioning System

PART A

QUESTION 1

a. With the aid of a diagram, define the following terms.

1) Great Circle
2) Spherical Triangle
3) Small Circle
4) Prime Vertical

b. Quango Airways believe that they have identified an opportunity to initiate a new non-stop air service between Adelaide and Cape Town (South Africa). The proposed route includes a segment from Kapunda (north of Adelaide) due west along a parallel of latitude (34^0 21' South) to the Cape of Good Hope near Cape Town. The new operations manager is certain that the route will simplify navigation. He is also convinced that flying along a parallel of latitude is the shortest route. "After all", he says, "it is shown as a straight line on this map." The map uses a Mercator projection.

1) Is the operations manager correct about the parallel of latitude being the shortest route? If not, why not?
2) Can you propose a shorter route between Kapunda and the Cape of Good Hope? Would navigating the shorter route be more complicated than navigating the parallel of latitude? Why?

[13]

QUESTION 2

a With the aid of diagrams, define the following terms:

1) Spheroid
2) Geoid
3) Ellipsoidal Normal
4) Geodetic Latitude
5) Normal Section
6) Geodesic

b A survey mark near Adelaide has a spheroidal height of 126.337 metres relative to the GDA94 datum. The geoid-spheroid separation (GDA94) at that point is +12.22 metres. What is the height of the point above sea level?

c You have been given the latitude and longitude of two points 80 Km apart. You have been requested to manually compute the azimuths and distance between the two points. A precise result is required but you have very limited time. It has been suggested that you should use Robbins formulae for the task. Do you agree or disagree with this suggestion (give reasons)? If you disagree, recommend an alternative approach.

[13]

QUESTION 3

a Define the following terms as they apply to map projections

1) Conformality;
2) Equidistance;
3) Equivalence;

b Which map projection would you recommend for use in each of the following projects? Give reasons for your answers. Discuss points/lines of contact, central meridians and central scale factors in each case.

1) A map of Antarctica to be used for air navigation;
2) A map of Australia depicting population density;
3) A topographic map of Lord Howe Island;
4) A project grid to be used in a major housing development at Mawson Lakes;
5) A national grid to support cadastral surveying.;

[13]

QUESTION 4

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, labeling

1) the projected spheroidal distance;
2) the plane distance;
3) the T-t corrections;
4) the azimuth angle from A to B;
5) the grid bearing angle from A to B;
6) the Grid Convergence angle.

DO NOT CALCULATE THE QUANTITIES

Point A	E 276,171.532	N 6,231,982.272
Point B	E 267,541.912	N 6,250,522.733

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

d Point D has the AGD84 coordinates S 28^0 29' 05.12435", E 145^0 52' 34.46551". In which AMG zone does this point lie? What is the central meridian of the zone?

[13]

QUESTION 5

a Discuss the difference between a local geodetic datum and a geocentric datum. Give an example of each.

b 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?

c You have been given AMG coordinates, the height above sea level, and the geoid-spheroid separation (relative to AGD84) 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 5 metres is required. Clearly describe the sequence of steps in the transformations process.

[13]

PART B

QUESTION 1

a Briefly discuss the following terms:

1) Pseudorange;
2) L1 Signal;
3) Broadcast Ephemeris;
4) C/A Code;
5) P Code;

b When using a single GPS receiver, it is usually necessary to simultaneously observe at least four GPS satellites to obtain 3D coordinates. Why?

c Describe the method of Differential GPS positioning using pseudoranges. What are the advantages and disadvantages of Differential GPS positioning when compared with GPS point positioning?

[15]

QUESTION 2

a Discuss the principles employed when processing GPS carrier phase measurements to produce high-accuracy relative positioning.

b Identify and discuss three key considerations to be addressed when planning the fieldwork for a precise GPS survey (i.e. a survey that will capture carrier phase data).

c Briefly identify the GPS equipment and methodology that would be needed for the following projects:

1) A survey to locate the position of electricity poles;
2) A project to monitor continental drift;
3) A survey to set out a land subdivision;
4) A project to monitor the movements of a species of animal;
5) A project to monitor the positions of fishing vessels.

[15]

QUESTION 3

Briefly discuss the following in relation to GPS:

1) Dilution of Precision;
2) Ionospheric errors and their minimisation;
3) Tropospheric errors and their minimisation;
4) Multipath errors and their minimisation;
5) Selective availability.

[10]

QUESTION 4

A GPS vector has been measured between points D and E using carrier-phase techniques. The vector components from D to E in geocentric Cartesian coordinates on the WGS84 datum are:

Difference in X - 10115.279 metres
Difference in Y - -7529.550 metres
Difference in Z - 6112.112 metres

The AMG coordinates of point D (on the Australian Geodetic Datum 1984 (AGD84)) are:

Zone -	54
East -	350113.226
North -	6325226.229
Height -	57.622 metres (above sea level)
Geoid-spheroid separation -	+13.22 metres

The geoid-spheroid separation at point E relative to AGD84 is 15.17 metres.

Assuming that all necessary transformation parameters are available to you, DESCRIBE the sequence of processes that you would apply to calculate AMG coordinates and height above sea level at point E. DO NOT PERFORM THE COMPUTATION.

[8]