UNIVERSITY OF SOUTH AUSTRALIA

FACULTY OF ENGINEERING AND THE ENVIRONMENT

SCHOOL OF GEOINFORMATICS, PLANNING AND BUILDING

SEMESTER 1, 2002

GEODETIC CONCEPTS : 10233

TIME ALLOWED : 2 HOURS + 10 MINUTES READING TIME

GENERAL INSTRUCTIONS TO CANDIDATES:

TOTAL MARKS = 120

ATTEMPT SIX QUESTIONS.

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

QUESTION 1

a. With the aid of a diagram (where necessary), define the following terms.

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

[4]

b) Joe Ocker is planning to establish an air-freight business between Australia, Japan and the United States. Equipped with a single Boeing 747 airliner, he is planning flights between a new international air-freight airport near Mt Gambier (Latitude 37^0 50' South, Longitude 140^0 40' East), Hitachi in Japan (Latitude 36^0 35' North, Longitude 140^0 40' East) and Monterey in the United States (Latitude 36^0 35' North, Longitude 121^0 53' West). Joe plans to fly his aircraft north along a meridian of longitude from Mt Gambier to Hitachi and then east along a parallel of latitude from Hitachi to Monterey.

Joe is certain that his selected route will simplify navigation. He is also convinced that flying along a meridian of longitude and a parallel of latitude represents the shortest route between the three locations. "After all", he says, "both sections of the flight appear as straight lines on this map." The map uses a Mercator projection and assumes that the Earth is sphere.

Is Joe correct about the meridian of longitude being the shortest route between Mt Gambier and Hitachi and the parallel of latitude being the shortest route between Hitachi and Monterey? If not, why not?

1) Can you propose a shorter route for either of the two sections of the flight? Would navigating the shorter route be more complicated than navigating Joe's proposed route? Why?

[16]

QUESTION 2

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

1) Spheroid
2) Semi-Major Axis
3) Ellipsoidal Normal
4) Geodetic Latitude
5) Geodesic

[5]

b A survey mark near Adelaide has a spheroidal height of 135.133 metres relative to the GDA94 datum. The geoid-spheroid separation (GDA94) at that point is +15.05 metres. What is the height of the point above sea level?

[3]

c You have been given the latitude and longitude of two points 1600 Km apart. You have been requested to manually compute the azimuths and distance between the two points. The result must be accurate to with 0.015 metres. 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.

[12]

QUESTION 3

a Define the following terms as they apply to map projections

1) Conformality
2) Equidistance
3) Equivalence

[6]

b The Stereographic, Universal Transverse Mercator and Lambert Conic Conformal projections are all examples of conformal projection. Discuss the differences between the three projections, including the projection surfaces, points/lines of contact, and distortion patterns. Also discuss appropriate applications for each projection.

[14]

QUESTION 4

a Define the following terms. Use diagrams to clarify your answers if necessary.

1) Graticule
2) Area Scale
3) Standard Lines
4) Rhumb Line

[4]

b A projection surface (plane, cone or cylinder) can be either tangential to the Earth or intersect the Earth on a secant. Discuss the advantages and disadvantages of both approaches. Under what circumstances would you use the secant approach in preference to the tangent approach?

[10]

c Briefly discuss the characteristics of the Orthographic and Gnomonic projections.

[6]

QUESTION 5

a The value of "line scale factor" and "point scale factor" on a Transverse Mercator Grid can both be calculated by more than one method, each one involving a greater degree of approximation. Show the formulae for calculating each one and list and explain the variables in each.

[8]

b What is the difference between the "grid bearing" and the "plane bearing" between two points, (for which we have grid coords)? What is "grid convergence" and how is it calculated?

[4]

c The above difference in grid and plane bearing is defined as **what** correction?
Show the formula for calculating this quantity and hence explain -
When is this value a maximum?
When is it a minimum?

[8]

QUESTION 6

WGS84 and GDA94 latitudes and longitudes are sometimes called the same. Describe how the two systems are derived and discuss the basic similarities and differences.

[20]

QUESTION 7

When reducing measured distances to the spheroid a surveyor used a "sea level correction" - which was a useful approximation for a locally derived "spheroid of best fit". Now that the "earth centred" Geocentric datum of Australia (GDA94) has been introduced surveyors need to be mindful of significant separations between the geoid and spheroid. Given that surveyors work with heights above sea level (on the Australian Height Datum) what steps would they need to take to reduce measured distances to the spheroid?

Clearly annotated diagrams are required.

[20]