UNIVERSITY OF SOUTH AUSTRALIA

DIVISION OF INFORMATION TECHNOLOGY, ENGINEERING AND THE ENVIRONMENT

School of Geoinformatics, Planning and Building

Semester 1, 2002

Geodetic Science 3 : GEOE 3005

Time Allowed : 3 hours + 10 minutes reading time

General Instructions to Candidates

Total marks = 100

This examination paper contains five (5) questions. Candidates are required to attempt FOUR questions only.

All questions are of equal value.

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

Attempt any FOUR (4) of the following FIVE (5) questions.

Question 1 [25 marks]

a) Briefly describe the signals and their associated frequencies which are transmitted by the GPS satellites. Show with the aid of a diagram how the phase modulation technique is applied to the L1 carrier.

[10 marks]

b) What is the basic difference between a confidence ellipsoid and a confidence ellipse?

[5 marks]

c) With the aid of diagrams, illustrate a GPS baseline survey which has no geometrical redundancy and one which has maximum geometrical redundancy.

[5 marks]

d) What impact has GPS had on the philosophy and approach used for establishing survey monumentation?

[5 marks]

Question 2 [25 marks]

a) EDM is a two-way ranging system whereas GPS only involves one-way ranging. What are the main differences between these two ranging techniques in terms of the basic observable, time measurement and the number of users that each system can accommodate at any given time?

[10 marks]

b) Explain with the aid of vector diagrams the following concepts: (1) point positioning, (2) relative positioning (static and kinematic) and (3) a network of points.

[5 marks]

c) Does a faster sampling rate increase the accuracy of a GPS baseline determination substantially? Explain your answer in terms of the impact of the sampling rate on both random and systematic GPS errors.

[5 marks]

d) Define the following terms that are often associated with the GPS signal: (1) pseudo random noise code, (2) binary biphase modulations and (3) spread spectrum.

[5 marks]

Question 3 [25 marks]

a) The design parameters for the conduct of a GPS survey can be categorized into seven broad groups. List these groups and the key factors within each group which should be considered during the design of a GPS survey.

[15 marks]

b) What are the major forces that act upon a GPS satellite? Should solar radiation forces be taken into account if precise (± 2m) GPS orbits are required for high precision surveying?

[5 marks]

c) Explain with the use of Newton's Law of Universal Gravitation $F = GMm/r^2$ why GPS satellite orbits tend to be "smoother" than the orbits of other satellites whose altitudes are closer to the earth's surface.

[

5 marks]

Question 4 [25 marks]

a) You have been allocated **three** (3) GPS receivers and have been contracted to coordinate **twelve** (12) survey control points. Given that (i) each survey point must be coordinated by **two** (2) independent baseline measurements and (ii) **two** (2) observing sessions are conducted each day, plan a stepwise design for the survey outlining the proposed configuration in each step (session). Estimate the total number of days it will take to complete the field survey.

[15 marks]

b) What are the main advantages and disadvantages of single and dual frequency GPS receivers?

[5 marks]

c) Describe the "rule of thumb" commonly used to evaluate the requirements for accurate satellite orbit information in relative GPS positioning. Calculate the error that a 50m bias in a satellite orbit will introduce on a GPS baseline 30km in length. [5 marks]

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Question 5 [25 marks]

a) All types of biases in the GPS observables are manifest as range errors unless they are modeled or eliminated. They can be categorized in three groups: (1) satellite dependent, (2) station dependent and (3) observation dependent. Briefly describe one type of bias from each of these groups and discuss a method for eliminating or reducing its impact on baselines determined by relative GPS positioning.

[10 marks]

b) Why do carrier phase observables produce more accurate positioning results than code measurements?

[5 marks]

c) Why is the GPS signal so complicated?

[5 marks]

d) In satellite surveying, the relationship between the reference ellipsoid and the geoid is given by the formula $h = H + N$. Define these three parameters and explain their significance in determining heights for topographic mapping using GPS techniques.

[5 marks]