

**The University of Melbourne
Semester 2 Assessment 2005**

**School of Agriculture and Food Systems
208-249
Landscape Information Systems**

Number of Students: 25
Reading Time: 15 minutes
Writing time: 3 hours

This paper has 6 pages.

Authorised materials:

Students may use any calculators and rulers.

Instructions to Invigilators:

Students will require examination booklets in which to answer questions

Instructions to Students:

Answer any 6 questions

Answer 6 questions only

Answer all questions in the examination booklets provided

Read all questions carefully

No part of the examination material may be removed from the examination room

Paper to be held by Library: Yes

Q1. A government department wishes to develop an organisation wide Decision Support System to help plan, document and evaluate resource management issues across Victoria.

- a) Briefly discuss 5 advantages of deploying a state wide database management system for such an undertaking as opposed to having individual manual systems which are often used at the local office level.
- b) In addition to the usual text and numerical data that most database systems can support, a GIS can also deal with spatially referenced data. Identify two key data formats that can be supported by a GIS and explain some of the key strengths and weaknesses of each data source. In particular address your comments toward the issues of speed of data transfer and spatial resolution.
- c) Highlight and briefly describe two of the current shortcomings of GIS technology.
- d) In what way can remotely sensed images become an important source of data for GIS analysis?

(5 + 4 + 4 + 3 = 15 Marks)

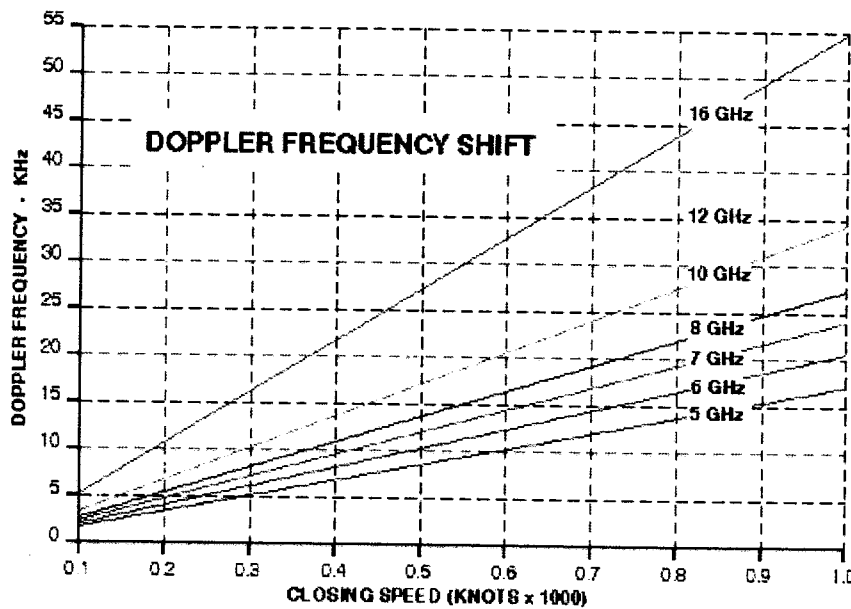
Q2. Remotely sensed images are a critical source of data for GIS. Most remotely sensed images are produced using electromagnetic radiation:

- a) With the aid of appropriate diagrams, explain what is meant by an "electromagnetic wave" and clearly define:
 - i. propagation speed and direction
 - ii. wave length and frequency
 - iii. polarization
 - iv. wave attenuation in different media
- b) Explain how remote sensing concepts involving specially designed sensors could be applied to allow aerial spotters to "see" the fire front through the smoke.
- c) Knowing that the speed of light can be calculated using $\frac{1}{\sqrt{\epsilon\mu}}$; where μ is the magnetic permeability and ϵ is the electrical permittivity of the medium through which the light is traveling, determine the speed of light in fresh water if: $\mu = 4\pi \times 10^{-7}$ Henries/m and $\epsilon = \frac{1.22}{36\pi} \times 10^{-9}$ Farads/m.

(8 + 4 + 3 = 15 Marks)

Q3. One of the major problems with satellite based imaging is being able to “see” the earth’s surface. With this in mind answer the following questions:

- a) Describe the underlying principles of radar. In your answer identify:
 - i. How it operates
 - ii. What part of the electromagnetic spectrum it uses
 - iii. Why SAR is important for good image resolution
- b) Satellite based radar systems can be used to map the earth’s surface in spite of cloud cover; however radar imaging has three major problems associated with it. These are “foreshortening”, “layover” and “shadows”. With the aid of appropriate diagrams, explain what these problems are and how they could distort the final image.
- c) A radar system sends a stream of microwave pulses with a frequency of 10 GHz. The reflection from a plane returns with a frequency that is 10 kHz above the original 10 GHz. Using the chart below determine the direction and speed the plane is moving relative to the radar source.



- d) There are two main orbital configurations used for remote sensing satellites. These are “Polar” and “Geosynchronous”. Identify the major features of each orbital configuration with particular emphasis on surface coverage, image resolution and time between revisits to the same location on the earth’s surface.

(3 + 6 + 2 + 4 = 15 Marks)

Q4. Global positioning systems are an important tool for spatial survey work.

- a) Describe the operational principles of the global positioning system, highlighting the “five steps” involved in the process.
- b) One of the major problems with GPS is accuracy. What are the major sources of inaccuracy associated with GPS and how is GPS accuracy improved by using two GPS units?

(10 + 5 = 15 Marks)

Q5. Geo-referencing of images in ArcView requires the creation of a “world file” to accompany the image:

- a) The world file contains 6 entries. Explain what each of these entries is and the order in which they should appear in the world file.
- b) An aerial photograph is to be used as part of a GIS project. GPS locations are available for two points on the image. The data details of the two points are outlined in the table below. Write the world file entries for the image.
- c) Explain why should there be a negative number associated with one of the entries in the world file.

(6 + 6 + 3 = 15 Marks)

Point Number	Horizontal Pixel Count	Vertical Pixel Count	GPS Easting	GPS Northing
1	164	54	383607	5974222
2	467	585	384250	5973081

Q6. With the aid of appropriate diagrams:

- a) Knowing that the aircraft was flying at 300 m when the photograph below was taken and that the focal length of the camera was 150 mm, determine the scale of the image.
- b) Knowing that $h = \frac{dH}{r}$; where H is the height of the aircraft (m), calculate the height of the tall building at the far left of the image. Note: this is the building which has been circled on the image.



- c) This is an image of a North American city. If the top of the image is assumed to be south, approximately what time of day would this image have been captured?
- d) Explain the concept of "Atmospheric Windows", illustrating how these features of the atmosphere lend themselves to both remote sensing activities and the overall balance of the earth's energy.

(3 + 3 + 3 + 6 = 15 Marks)



Q7 From the image of Melbourne city above:

- a) Using a “grid” analysis technique, determine the percentage of this image dedicated to “gardens”.
- b) If the image covers a strip of land which is 2.4 km wide, determine the length of the river shown in the image.
- c) One of the important features of a GIS is its ability to create useful output from individual data sets which concentrate on only one feature of the landscape. These are called “Themes” in ArcView. From this image of Melbourne sketch “thematic” maps in your exam booklet showing:
 - i. Rivers
 - ii. Freeways and rail systems (Including the location of any special features such as stations and tunnels)
 - iii. Sporting facilities

(5 + 4 + 6 = 15 Marks)

****End of Exam Paper ****