CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-7 REMOTE SENSING & PHOTOGRAMMETRY — October 2010

Although programmable calculators may be used, candidates must show all formulae used, the substitution of values into them, and any intermediate values to 2 more significant figures than warranted by the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

Note: This examination consists of 12 questions on 2 pages. Time: 3 hours

Q. No		Marks Value	Earned
1.	a) Why is it important to reduce the aberration and distortion effects in aerial imagery?	2	
	b) What is meant by the depth of field? What are the factors that affect the depth of field of a digital imaging system?	4	
	c) Where in the image is there no radial lens distortion? Why?	2	
2.	a) List the required input and the necessary steps required to produce an orthophoto using differential rectification?	5	
	b) The dimensions of a square in the center of a pre-marked panel on a photo negative are required to be 0.04 mm x 0.04 mm. If the focal length of the camera is 6" and the flight height is 6500′ above the average terrain elevation, what should be the dimensions of the square on the ground?	3	
3.	a) Describe the conceptual basis of image smoothing in the frequency domain.	2	
	b) Describe the conceptual basis of image sharpening (enhancement) in the frequency domain.	2	
	c) How many ground control points are needed to establish the relative orientation between the images of a stereo-pair? Why?	2	
	d) How many ground control points are needed to establish the absolute orientation of a 3D model? Why?	2	
4.	a) You are given a stereo-pair with identified twenty-six tie points. List the balance between the observables and the unknown parameters in a bundle adjustment procedure to solve for the exterior orientation parameters as well as the ground coordinates of tie points. Can you estimate the involved unknown parameters? Why?	4	
	b) What are the alternative methodologies for establishing the exterior orientation parameters of an imaging system?	4	
5.	a) Do we need Fiducial marks for metric digital cameras? Why?	2	
	b) What are the main characteristics of a metric camera?	2	
	c) What are the key information items you expect to have in a camera calibration certificate for a metric analogue camera?	3	
6.	a) What are the main differences between the scene acquisition procedures for frame and line cameras?	3	
	b) What are the different alternatives for stereo-coverage using line cameras?	3	
	c) What are the sources of digital imagery? Which source do you prefer if the same quality can be attained? Why?	3	
7.	a) Satellite remote sensing systems avoid detecting and recording wavelengths in the Ultraviolet portion of the spectrum. Why?	2	
	b) What is the maximum number of independent rotation angles needed to define a three-dimensional rotation matrix? Why?	3	
	c) What are the parameters that are solved for in the following photogrammetric problems: i) Single photo resection, ii) Photogrammetric intersection, iii) Bundle adjustment, and iv) Bundle adjustment with self-calibration?	6	

8.	a) At the bottom of a valley, the scale of a vertical photograph is 1:7000. The focal length of the lens used to capture the photograph is 6". A road intersection on the same photograph is 400′ above the valley floor and 3.59" from the principal point. What is the relief displacement of the road intersection with respect to the bottom of the valley? b) Aerial images have varying scale. Use a sketch to illustrate this fact. Sketch a special case where the scale in a photograph is considered constant.	6 3	
9.	a) What is the conceptual basis of the Collinearity equations? b) What is the conceptual basis of the Coplanarity condition? c) Give a brief definition of the following entities: i. Nadir point, ii. principal point, iii. principal distance, iv. flying height, v. X and Y -axes of the image coordinate system.	2 2 4	
10.	The following is a 3x3 sub-image of a remote sensing scene: 95 94 84 86 35 86 100 86 87 Derive the smoothed value at the central pixel using the following filters: a) 3x3 moving average, b) 3x3 median filter, and c) the following smoothing mask $\frac{1}{14}\begin{bmatrix}1 & 1 & 1\\ 1 & 6 & 1\\ 1 & 1 & 1\end{bmatrix}$	6	
11.	a) What is meant by accuracy and precision? b) What are the factors affecting the precision of the outcome from a photogrammetric bundle adjustment procedure? c) What are the factors affecting the accuracy of the outcome from a photogrammetric bundle adjustment procedure? d) How would you evaluate the precision and the accuracy of the outcome from a photogrammetric bundle adjustment procedure?	2 2 2 2	
12.	a) Briefly explain the following terms: i) Registration, ii) Geo-coding, and iii) Ortho-rectification. b) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	6 4	
	Total Marks:	100	