CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

SCHEDULE I / ITEM 4 — March 2009
APPLIED PHOTOGRAMMETRY AND REMOTE SENSING

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) What is meant by establishing the exterior orientation parameters for an imaging system?	2	
	b) What is meant by establishing the relative orientation between the images of a stereo-pair?	2	
	c) How many ground control points are needed to establish the relative orientation between the images of a stereo-pair? Why?	2	
	d) What is the objective of photogrammetric triangulation?	2	
2	a) You are given a stereo-pair with identified twenty-four 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?	5	
	b) What are the alternative methodologies for establishing the exterior orientation parameters of an imaging system?	4	
3	a) Using a sample 2D rotation matrix, list the orthogonality conditions of such a matrix.	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 standard photogrammetric problems: 1) Single photo resection, 2) photogrammetric intersection, 3) Bundle adjustment, and 4) Bundle adjustment with self-calibration?	6	
4	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 you expect to have in a camera calibration certificate for a metric analogue camera?	3	
5	a) What are the roles of tie points, ground control points, and check points in a bundle adjustment procedure?	4	
	b) The dimensions of a square in the center of a pre-marked panel on a photo negative are required to be 0.02 mm x 0.02 mm. If the focal length of the camera is 6" and the flight height is 5000′ above the average terrain elevation, what should be the dimensions of the square on the ground?	4	
	c) How can you differentiate between light poles and their shadows in an image?	2	
6	a) At the bottom of a valley, the scale of a vertical photograph is 1:8000. The focal length of the lens used to capture the photograph is 6". A road intersection on the same photograph is 495′ above the valley floor and 3.99" from the principal point. What is the relief displacement of the road intersection with respect to the bottom of the valley?	6	
	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.	3	
7	a) Where in the image is there no atmospheric refraction effect? Why?	2	
	b) Where in the image is there no radial lens distortion? Why?	2	
	c) Where in the image is there no relief displacement? Why?	2	

8	a) What are the typical overlap and side-lap ratios between images within a block? What is the motivation behind repeated coverage of the same area on the ground? b) What are the advantages of Radar remote sensing systems? c) Briefly explain the following terms together with the factors that control them for a given digital imaging system: 1) Radiometric resolution, 2) Spectral resolution, and 3) Geometric resolution.	3 2 6	
9	An aerial camera with IMC is used to acquire photography at a flying height of 5200 m above ground. The focal length is 153.15 mm. The aircraft is flying at 325 km/hr and an exposure time of 1/250 second is used. How far across the focal plane must film travel during the exposure in order to obtain an image with no image motion blurring?	6	
10	The following is a 3x3 sub-image of a remote sensing scene: 95 94 84 86 27 96 100 97 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 $\frac{1}{12}\begin{bmatrix}1 & 1 & 1\\ 1 & 4 & 1\\ 1 & 1 & 1\end{bmatrix}$	6	
11	a) What are the factors affecting the precision of the outcome from a photogrammetric bundle adjustment procedure? b) What are the factors affecting the accuracy of the outcome from a photogrammetric bundle adjustment procedure? c) How would you evaluate the precision and the accuracy of the outcome from a photogrammetric bundle adjustment procedure?	2 2 2	
12	a) Briefly explain the following terms: 1) registration, 2) geo-coding, and 3) ortho-rectification. b) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	6 5	
	Total Marks:	100	