CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

SCHEDULE I / ITEM 4 **March 2010**

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 **Marks**

Q. No	Time: 3 hours	Value	Earned
1.	a) Explain why active microwave systems are more suited for high resolution remote sensing when compared to passive microwave systems. b) What is the EM radiation waveband used in LiDAR systems? Are they active or passive systems? c) Where in the image is there no radial lens distortion? Why?	2 2 2	
2.	a) Briefly explain the utilized procedure for evaluating the accuracy of a classification procedure. 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) Ground Sampling Distance (GSD).	3 2 6	
3.	An aerial camera with IMC is used to acquire photography at a flying height of 4500 m above ground. The focal length is 152.25 mm. The aircraft is flying at 325 km/hr and an exposure time of 1/350 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	
4.	The following is a 3x3 sub-image of a remote sensing scene: 95 94 84 86 37 86 100 87 85 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	
5.	a) What is meant by accuracy and precision? In the outcome of a photogrammetric bundle adjustment procedure: b) what are the factors affecting the precision? c) what are the factors affecting the accuracy? d) how would you evaluate the precision and the accuracy?	2 2 2 2	

6.	a) Briefly explain the following terms: 1) Registration, 2) Geo-coding, and 3) Ortho-rectification. a) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	6 5	
7.	a) List the required input and the necessary steps required to produce an orthophoto using differential rectification. b) The dimensions of a square in the center of a pre-marked panel on a photo negative are required to be 0.03 mm x 0.03 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 4	
8.	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 500′ above the valley floor and 3.79" 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) Describe the conceptual basics of image smoothing in the frequency domain. b) Describe the conceptual basics of image sharpening (enhancement) in the frequency domain. c) How many ground control points are needed to establish the relative orientation between the images of a stereo-pair? Why? d) How many ground control points are needed to establish the absolute orientation of a 3D model? Why?	2 2 2 2	
10.	a) You are given a stereo-pair with identified twenty-eight 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? b) What are the alternative methodologies for establishing the exterior orientation parameters of an imaging system?	5 4	
11.	a) Satellite remote sensing systems avoid detecting and recording wavelengths in the Ultraviolet portion of the spectrum. Why? b) What is the maximum number of independent rotation angles needed to define a three-dimensional rotation matrix? Why? 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?	2 3 6	
12.	a) Do we need Fiducial marks for metric digital cameras? Why? b) What are the main characteristics of a metric camera? c) What are the key information items you expect to have in a camera calibration certificate for a metric analogue camera?	2 2 3	
	Total Marks:	100	