

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-7 REMOTE SENSING & PHOTOGRAMMETRY

March 2011

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.

<u>Q. No</u>	<u>Time: 3 hours</u>	<u>Marks</u>	
		<u>Value</u>	<u>Earned</u>
1.	a) List the required input and necessary steps for generating an orthophoto using differential rectification.	5	
	b) Describe the conceptual basis of image smoothing in the frequency domain.	3	
	c) Describe the conceptual basis of image sharpening (enhancement) in the frequency domain.	3	
2.	a) How many ground control points are needed to establish the relative orientation between the images of a stereo-pair? Why?	2	
	b) How many ground control points are needed to establish the absolute orientation of a 3D model? Why?	2	
	c) 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	
3.	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	
4.	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) Tabulate the advantages and disadvantages of the systems using the following parts of the EMR: visible, infrared, and microwave (passive & active).	4	
5.	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	
6.	a) What is meant by accuracy and precision?	2	
	b) What are the factors affecting the precision of the outcome from a photogrammetric bundle adjustment procedure?	2	
	c) What are the factors affecting the accuracy of the outcome from a photogrammetric bundle adjustment procedure?	2	
	d) How would you evaluate the precision and the accuracy of the outcome from a photogrammetric bundle adjustment procedure?	2	
7.	a) Briefly explain the following terms: 1) Registration, 2) Geo-coding, and 3) Ortho-rectification.	6	
	b) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	4	

8.	a) At the bottom of a valley, the scale of a vertical photograph is 1:5000. The focal length of the lens used to capture the photograph is 6". A road intersection on the same photograph is 200' above the valley floor and 3.49" from the principal point. What is the relief displacement of the road intersection with respect to the bottom of the valley?	6										
	b) Briefly explain one of the procedures for evaluating the accuracy of a classification procedure.	3										
9.	a) An aerial camera with IMC is used to acquire photography at a flying height of 4000 m above ground. The focal length of this camera is 150.00 mm. The aircraft is flying with a speed of 250 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?	4										
	b) What is the EM radiation used in LiDAR systems? Are they active or passive systems?	2										
10.	<p>The following is a 3x3 sub-image of a remote sensing scene:</p> <table style="margin-left: 40px;"> <tr><td>90</td><td>92</td><td>83</td></tr> <tr><td>86</td><td>42</td><td>94</td></tr> <tr><td>98</td><td>88</td><td>87</td></tr> </table> <p>Derive the smoothed value at the central pixel using the following filters:</p> <p>a) 3x3 moving average, b) 3x3 median filter, and c) the following smoothing mask</p> $\frac{1}{12} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 4 & 1 \\ 1 & 1 & 1 \end{bmatrix}$	90	92	83	86	42	94	98	88	87	6	
90	92	83										
86	42	94										
98	88	87										
11.	a) What is the conceptual basis of the photogrammetric Collinearity equations?	2										
	b) What is the conceptual basis of the photogrammetric Coplanarity condition?	2										
	c) Give a brief definition of the following entities: Nadir point, principal point, principal distance, flying height, as well as optical axis of a lens system.	4										
12.	a) What is meant by the depth of field? What are the factors that affect the depth of field of a digital imaging system?	3										
	b) What is meant by the depth of focus? What are the factors that affect the depth of focus of a digital imaging system?	3										
Total Marks:		100										