

**CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS**

**C7 – REMOTE SENSING & PHOTOGRAMMETRY**

October 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) 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 thirty-six tie points. List the balance between the observables and 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										
2.	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										
3.	a) Briefly explain the following terms: i) Registration, ii) Geo-coding, and iii) Ortho-rectification.	6										
	b) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	4										
4.	<p>The following is a 3x3 sub-image of a remote sensing scene:</p> <table border="0" style="margin-left: 40px;"> <tr><td>90</td><td>92</td><td>83</td></tr> <tr><td>86</td><td>80</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> $\frac{1}{10} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix}$	90	92	83	86	80	94	98	88	87	6	
90	92	83										
86	80	94										
98	88	87										
5.	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										
6.	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										

7.	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	
8.	a) At the bottom of a valley, the scale of a vertical photograph is 1:7500. The focal length of the lens used to capture the photograph is 6". A road intersection on the same photograph is 350' 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) 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	
9.	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	
10.	a) Explain why active microwave systems are more suited for high resolution remote sensing when compared to passive microwave systems	2	
	b) What is the EM radiation waveband used in LiDAR systems? Are they active or passive systems?	2	
	c) Where in the image is there no radial lens distortion? Why?	2	
11.	An aerial camera with IMC is used to acquire photography at a flying height of 4500 m above ground. The focal length is 150.00 mm. The aircraft is flying at 300 km/hr and an exposure time of 1/300 second is used. How far across the focal plane must the film travel during the exposure in order to obtain an image with no image motion blurring?	6	
12.	a) What are the alternative methodologies for deriving the Exterior Orientation Parameters (EOP) of an image block?	2	
	b) Classify and describe the types of points based on their role in a photogrammetric bundle adjustment procedure.	2	
	c) Classify and describe the types of points based on their appearance in photogrammetric images.	2	
	d) What are the necessary conditions for stereo-viewing in digital photogrammetric workstations?	3	
	e) Do we need Fiducial marks for metric digital cameras? Why?	2	
<b>Total Marks:</b>		100	