

**CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS**

**C-7 REMOTE SENSING & PHOTOGRAMMETRY**

March 2012

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 for 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.	<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>81</td><td>94</td></tr> <tr><td>98</td><td>85</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	81	94	98	85	87	6	
	90	92	83									
86	81	94										
98	85	87										
2.	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, focal length, flying height, as well as optical axis of a lens system.	3										
3.	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										
4.	a) What are the alternative methodologies for deriving the Interior Orientation Parameters (IOP) of a photogrammetric camera?	2										
	b) Classify and describe the types of points based on their role in a photogrammetric bundle adjustment procedure.	2										
	c) Do we need Fiducial marks for metric digital cameras? Why?	2										
	d) Explain why active microwave systems are more suited for high resolution remote sensing when compared to passive microwave systems.	2										
	e) What is the EM radiation waveband used in LiDAR systems? Are they active or passive systems?	2										
5.	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										

6.	a) What are the typical overlap and side-lap ratio between images within a block? What is the motivation behind repeated coverage of the same area on the ground?	3	
	b) What are the advantages of RADAR remote sensing systems?	2	
	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.	6	
7.	a) Explain how can you use the spectral reflectance curve to identify the moisture content in vegetation and soil?	2	
	a) What are the main characteristics of a metric camera?	2	
	b) What are the key information items you expect to have in a camera calibration certificate for a metric analogue camera?	2	
8.	a) What is the maximum number of independent rotation angles needed to define a three-dimensional rotation matrix? Why?	2	
	b) What are the parameters that are solved for in the following photogrammetric problems: 1) Single photo resection, 2) Photogrammetric intersection, 3) Bundle adjustment, and 4) Bundle adjustment with self-calibration?	6	
9.	a) You are given a stereo-pair with identified twenty-seven 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) 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 515' above the valley floor and 4.19" from the principal point. What is the relief displacement of the road intersection with respect to the bottom of the valley?	6	
10.	a) Briefly explain the following terms: 1) Registration, 2) Geo-coding, and 3) Ortho-rectification.	5	
	b) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	5	
11.	An aerial camera with IMC is used to acquire photography at a flying height of 4000 m above ground. The focal length is 150.00 mm. The aircraft is flying at 350 km/hr and an exposure time of 1/350 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) 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.	2	
	b) How many ground control points are needed to establish the relative orientation between the images of a stereo-pair? Why?	2	
	c) How many ground control points are needed to establish the absolute orientation of a 3D model? Why?	2	
<b>Total Marks:</b>		100	