

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-7 REMOTE SENSING & PHOTOGRAMMETRY

October 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.

<u>Q. No</u>	<u>Time: 3 hours</u>	<u>Marks</u>	
		<u>Value</u>	<u>Earned</u>
1.	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	
2.	a) Explain how you can use the spectral reflectance curve to identify the moisture content in vegetation and soil.	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?	2	
3.	a) What is the maximum number of independent rotation angles needed to define a three-dimensional rotation matrix? Why?	2.5	
	b) What are the parameters that are solved for in the following photogrammetric problems: 1) Single photo resection, 2) Photogrammetric intersection, 3) Bundle adjustment, 4) Independent relative orientation, and 5) Bundle adjustment with self-calibration?	7.5	
4.	a) You are given a stereo-pair with 28 identified 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	
	b) At the bottom of a valley, the scale of a vertical photograph is 1:6000. The focal length of the lens used to capture the photograph is 6". A road intersection on the same photograph is 510' above the valley floor and 4.29" from the principal point. What is the relief displacement of the road intersection with respect to the bottom of the valley?	5	
5.	a) Briefly explain the following terms: 1) Registration, 2) Geo-coding, and 3) Ortho-rectification.	4.5	
	b) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	5.5	
6.	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.	2	
	c) Describe the conceptual basis of image sharpening (enhancement) in the frequency domain.	2	
7.	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	

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?	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										
9.	An aerial camera with IMC is used to acquire photography at a flying height of 3600 m above ground. The focal length is 152.00 mm. The aircraft is flying at 360 km/hr and an exposure time of 1/360 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?	5										
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>84</td></tr> <tr><td>86</td><td>82</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> $\frac{1}{10} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix}$	90	92	84	86	82	94	98	85	87	6	
90	92	84										
86	82	94										
98	85	87										
11.	a) Classify and describe the types of points based on their role in a photogrammetric bundle adjustment procedure.	2										
	b) How are the image coordinate systems defined in:	2										
	a. a digital image scanned from a photograph captured by an analogue metric camera, and											
	b. a digital image acquired by a digital metric camera?											
	c) What is the EM radiation waveband used in LiDAR systems? Are they active or passive systems?	2										
	d) Where in the image is there no atmospheric refraction effect? Why?	2										
e) Where in the image is there no radial lens distortion? Why?	2											
f) Where in the image is there no relief displacement? Why?	2											
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										
	c) How would you evaluate the precision and the accuracy of the outcome from a bundle adjustment procedure?	3										
Total Marks:		100										