

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-7 REMOTE SENSING & PHOTOGRAMMETRY

October 2014

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 twelve questions on two 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 Coplanarity condition?	2	
	b) What is the conceptual basis of the photogrammetric Collinearity equations?	2	
	c) Give a brief definition of the following entities: Nadir point, principal point, principal distance, focal length, principal planes, as well as optical axis of a lens system.	3	
2.	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) Explain why active microwave systems are more suited for high resolution remote sensing when compared to passive microwave systems.	2	
	d) What is the EM radiation waveband used in LiDAR systems? Are they active or passive systems?	2	
3.	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	
4.	a) What are the advantages of RADAR remote sensing systems?	2	
	b) Briefly explain the following terms together with the factors that control them for a given digital imaging system: 1) Radiometric resolution, 2) Spectral resolution, 3) Geometric resolution, and 4) Temporal resolution.	8	
5.	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	
	a) What are the key information items you expect to have in a camera calibration certificate for a metric digital camera?	2	
6.	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	
7.	a) Briefly explain the following terms: 1) Registration, 2) Geo-coding, and 3) Ortho-rectification.	4	
	b) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	4	

8.	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	
9.	a) List the required input and necessary steps for generating an orthophoto using differential rectification.	4	
	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	
	d) What are the main differences between the scene acquisition procedures for frame and line cameras?	2	
10.	a) What are the alternative methodologies for establishing the exterior orientation parameters of an imaging system? What is the objective of a bundle adjustment procedure involving an image block with ground control and tie points? How are the image coordinate systems defined in: 1) an analogue photograph acquired by an analogue metric camera, 2) digital image scanned from an analogue photograph captured by an analogue metric camera, and 3) a digital image acquired by a digital metric camera?	4	
		3	
		3	
11.	a) You have a digital B/W (8 bits/pixel) and a color (24 bits/pixel) image. Comment on the radiometric and spectral resolutions of these images (i.e., which one has higher radiometric and which one has higher spectral resolution).	3	
	b) What are the quantities measured by a GPS/INS system onboard an imaging platform? What are the main requirements for relating these measurements to the exterior orientation parameters of the exposure stations?	6	
12.	a) You are given a stereo-pair with identified thirty-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?	5	
	b) A distance between 2 points on a map at a scale of 1:65,000 is 30.85 mm. The distance between the same points on a vertical photo taken with a 152.24 mm focal length camera is 41.19 mm. If both points lie at an elevation of 112 meters, compute the flying height above datum.	5	
Total Marks:		100	