

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C7 - REMOTE SENSING & PHOTOGRAMMETRY

March 2016

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 ten questions on two pages.

<u>Q. No</u>	<u>Time: 3 hours</u>	<u>Marks</u>	
		<u>Value</u>	<u>Earned</u>
1.	a) Why is it important to reduce the aberration and distortion effects in aerial imagery?	2	
	b) What is meant by the depth of field and depth of focus? What are the factors that affect the depth of field and depth of focus of a digital imaging system?	4	
	c) Where in the image is there no radial lens distortion? Why?	2	
	d) Where in the image is there no relief displacement? Why?	2	
2.	a) List the required input and the necessary steps required to produce an orthophoto using differential rectification.	4	
	b) The dimensions of a square in the center of a pre-marked panel on a photo negative are required to be 0.03 mm x 0.03 mm. If the focal length of the camera is 6" and the flight height is 6500' above the datum, what should be the dimensions of the square on the ground that is 200' above the datum?	2	
	c) How many ground control points are needed to establish the relative orientation between the images of a stereo-pair? Why?	2	
	d) How many tie points are needed to establish the relative orientation between the images of a stereo pair? Why?	2	
3.	a) Describe the conceptual basis and necessary steps of image smoothing in the frequency domain.	2	
	b) Describe the conceptual basis and necessary steps of image sharpening (enhancement) in the frequency domain.	2	
	c) 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?	3	
	d) What are the alternative methodologies for establishing the exterior orientation parameters of an imaging system?	3	
4.	a) Do we need Fiducial marks for metric digital cameras? Why?	2	
	b) What are the main characteristics of a metric analogue camera?	2	
	c) What are the key information items you expect to have in a camera calibration certificate for a metric analogue camera?	3	
	d) What are the different alternatives for stereo-coverage using line cameras?	3	
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?	2	
	c) Explain the conceptual basis of the Collinearity Equations, Direct Linear Transformation, Projective Transformation, and Rational Functional Models for relating corresponding scene and object coordinates.	6	
6.	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	

7.	a) How is the perspective center defined for the lens assembly for a digital camera system?	2	
	b) 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	
	c) What is the MINIMUM number and optimal configuration of ground control points needed to establish the absolute orientation of a 3D model? Why?	2	
	d) What are the alternative methodologies for deriving the Interior Orientation Parameters (IOP) of a photogrammetric camera? Which one would you prefer to adopt? Why?	3	
8.	a) What is the EM radiation waveband used in RADAR remote sensing systems? Are they active or passive systems?	2	
	b) What are the advantages of RADAR remote sensing systems?	2	
	c) 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?	4	
	d) What are the main differences between the scene acquisition procedures for frame and line cameras?	2	
9.	a) 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.	6	
	b) Explain how you can use the spectral reflectance curve to identify the moisture content in vegetation and soil.	2	
	c) One can argue that digital cameras can see through shadow. Do you agree with this statement? Why?	2	
10.	a) What are the parameters that are solved for in the following photogrammetric problems: 1) Single photo resection; 2) Photogrammetric intersection; 3) Bundle adjustment; 4) Bundle adjustment with self-calibration; 5) Dependent relative orientation for a stereo-pair; and 6) Independent relative orientation for a stereo-pair)?	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.	2	
	c) What are the involved parameters and the underlying assumption of the lens equation?	2	
Total Marks:		100	