CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C7 - REMOTE SENSING & PHOTOGRAMMETRY **March 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 ten questions on two pages.

Q. No Time: 3 hours **Marks** Value Earned

1.	a) What is the maximum number of independent rotation angles needed to define a two-dimensional rotation matrix? Why?	2	
	b) What is the maximum number of independent rotation angles needed to define a three-dimensional rotation matrix? Why?	2	
	c) 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	
2.	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) What is the minimum number of ground control points that are needed to establish the absolute orientation of a 3D model? Why?	2	
	d) What is the minimum number of tie points that are needed to establish the relative orientation parameters for a stereo pair?	2	
	e) Explain how the image aberrations and distortions affect the precision and accuracy of the outcome from the photogrammetric reconstruction.	2	
3.	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) Where in the image is there no radial lens distortion? Why?	2	
	d) Where in the image is there no relief displacement? Why?	2	
4.	a) What are the necessary conditions for 3D viewing of 2D imagery?	2	
	b) What is the objective of a bundle adjustment procedure involving an image block with ground control and tie points?	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, 3) Geometric resolution, and Temporal resolution.	6	

5.	a) What are the alternative methodologies for deriving the interior orientation parameters of an imaging system? b) What are the alternative methodologies for deriving the exterior orientation parameters of an imaging system? c) What are the main characteristics of a metric analogue camera? d) How are the image coordinate systems defined in: 1) an analogue photograph acquired by an analogue metric camera, 2) a digital image scanned from an analogue photograph captured by an analogue metric camera, and 3) a digital image acquired by a digital metric camera?	3 2 2 3	
6.	a) Classify and describe the types of points based on their role in a photogrammetric bundle adjustment procedure. b) Classify and describe the types of points based on their appearance in analogue images. c) Explain why active microwave systems are more suited for high resolution remote sensing when compared to passive microwave systems. d) What is the EM radiation waveband used in LiDAR systems? Are they active or passive systems? e) What are the advantages of RADAR remote sensing systems?	2 2 2 2 2	
7.	a) Briefly explain the following terms: 1) Registration, 2) Geo-coding, and 3) Ortho-rectification. b) What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	5 5	
8.	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). 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? c) You are given a stereo-pair with identified 37 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 3 4	
9.	a) What is the conceptual basis of the photogrammetric Collinearity equations? b) What is the conceptual basis of the photogrammetric Coplanarity condition? 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. d) A distance between 2 points on a map at a scale of 1:60,000 is 29.75 mm. The distance between the same points on a vertical photo taken with a 152.24 mm focal length camera is 40.29 mm. If both points lie at an elevation of 112 meters, compute the flying height above datum.	2 2 3 3	
10.	a) List the required input and necessary steps for generating an orthophoto using differential rectification. b) Describe the conceptual basis of image smoothing in the frequency domain. c) Describe the conceptual basis of image sharpening (enhancement) in the frequency domain. d) What are the main differences between the scene acquisition procedures for frame and line cameras?	4 2 2 2	
	Total Marks:	100	