## **CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS**

## C7 – REMOTE SENSING & PHOTOGRAMMETRY

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: 7	This examination consists of 10 questions on 3 pages.	Mar	<u>·ks</u>
<u>Q. No</u>	Time: 3 hours	Value	Earned
1.	<ul> <li>a) Do we need Fiducial marks for metric digital cameras? Why?</li> <li>b) Briefly explain the following terms and how they are evaluated for a digital imaging system: 1) Geometric resolution, 2) Radiometric resolution, 3) Spectral resolution, and 3) Temporal resolution.</li> <li>c) Where in the image is there no radial lens distortion? Why?</li> </ul>		
2.	The Figure below shows a 3D schematic diagram of a building and the associated ground coordinate system (in black – upper case <i>XYZ</i> ) as well as the image/camera coordinate systems for two images (in grey – lower case <i>xyz</i> ) that have been captured around the building. What will be the approximate values you would use for the rotation angles ( $\omega$ , $\varphi$ , and $\kappa$ ) for these images in a bundle adjustment procedure? Why? Would you expect any problem in the estimation of these rotation angles in the bundle adjustment procedure? Why?		
3.	What is the rotation matrix that relates the coordinate systems in the figure below – given that $r_{o_2a}^{x_1y_1x_1} = \begin{bmatrix} 6 & 8 & 10 \end{bmatrix}^T$ and $r_{o_2b}^{x_1y_1x_1} = \begin{bmatrix} -6 & -8 & 10 \end{bmatrix}^T$ ? Briefly explain how did you drive such a rotation matrix.	14	

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<ul> <li>4.</li> <li>S</li> <li>In</li> <l< td=""><td>ndependent relative orientation of a stereo-pair,</td><td></td><td></td></l<></ul>	ndependent relative orientation of a stereo-pair,		
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<ul> <li>d) What probl</li> <li>Bund relating a ster</li> <li>a) Satelli the ul</li> <li>b) The distribution of the constraint of the cons</li></ul>	t is the maximum number of independent rotation angles needed to define	2	
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<ul> <li>6. require</li> <li>6. and the of the of the c) Explained to the contract of the cont</li></ul>	ltraviolet portion of the spectrum. Why?		
<ul> <li>6. and the of the of the c) Explate Transformer</li> <li>a) How</li> <li>a) How</li> <li>1</li> <li>2</li> <li>3</li> <li>7. 4</li> <li>5</li> <li>6</li> <li>b) What unsure freque</li> <li>b) What (1/in c) You a</li> </ul>	limensions of a square in the center of a pre-marked panel on a photo are	2	
<ul> <li>of the</li> <li>c) Expla</li> <li>Trans</li> <li>for re</li> <li>a) How</li> <li>1</li> <li>2</li> <li>3</li> <li>7. 4</li> <li>5</li> <li>6</li> <li>b) What</li> <li>unsup</li> <li>a) Descr</li> <li>frequ</li> <li>b) What</li> <li>(1/in</li> <li>c) You a</li> </ul>	red to be $0.045 \text{ mm x } 0.045 \text{ mm}$ . If the focal length of the camera is 6"		
c) Expla Trans for re a) How 1 2 3 7. 4 5 6 b) What unsup 6 b) What (1/ <i>in</i> c) You a	he flight height is 6500' above the datum, what should be the dimensions		
Trans for rea) How1237.456b) Whatunsupa) Descrfrequb) What(1/inc) You a	e square on the ground that is 300' above the datum?		
for rea)How1237.456b)Whatunsura)Descrfrequb)What(1/inc)You a	ain the conceptual basis of the Collinearity Equations, Direct Linear	6	
a) How 1 2 3 7. 4 5 6 b) What unsup a) Descr frequ b) What (1/ <i>in</i> c) You a	sformation, Projective Transformation, and Rational Functional Models		
1         2         3         7.       4         5         6         b) What         unsup         a) Descr         frequ         b) What         (1/in)         c) You a	elating corresponding scene and object coordinates.	4	
7.         2           7.         4           5         6           b)         What           unsup         a)         Descr           frequ         b)         What           (1/in)         c)         You at	would the camera aperture size affect the following:	4	
7. 4 5 6 b) What unsup a) Descr frequ b) What (1/ <i>in</i> c) You a	. Aberrations, Chromatic aberrations,		
7. 4 5 6 b) What unsup a) Descr frequ b) What (1/ <i>in</i> c) You a			
a) Descr frequ b) What (1/in c) You a	. Diffraction, Depth of field		
a) Descr frequ b) What (1/in c) You a	<ul><li>Depth of field,</li><li>Depth of focus, and</li></ul>		
b) What unsur a) Descri- frequ b) What (1/in c) You a	. Motion blur?		
a) Descr frequ b) What (1/in c) You a	are the main characteristics/differences between supervised and	4	
a) Descr frequ b) What (1/in c) You a	pervised classification strategies? Tabulate your answer.		
b) What (1/in c) You a	ribe the conceptual basis and necessary steps of image smoothing in the	2	
b) What (1/in c) You a	ency domain.		
c) You a	t are the image formation principles used for deriving the lens equation	2	
c) You a	nage distance + $1/object$ distance = $1/f$ ocal length)?		
		3	
•	neters? Why?		
·	are the alternative methodologies for establishing the exterior orientation	3	
	neters of an imaging system?		
adjus the g	are given a stereo-pair with identified thirty-five tie points. List the lice between the observables and the unknown parameters in a bundle timent procedure to solve for the exterior orientation parameters as well as round coordinates of tie points. Can you estimate the involved unknown neters? Why?	3	

9.	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	3	
	c)	lens system. 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	
	a)	What is the EM radiation waveband used in LiDAR remote sensing systems?	2	
		Are they active or passive systems?		
	b)	What are the advantages of RADAR remote sensing systems?	2	
10.	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)	How are the precision and accuracy of the outcome from a photogrammetric		
		reconstruction evaluated?	2	
		Total Marks:	100	