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SCHEDULE I / ITEM 4   **October 2005**

REMOTE SENSING & APPLIED PHOTOGRAMMETRY

Note: **This examination consists of 12 questions on 3 pages.**   **Marks**

Q. No	Time: 3 hours	Value	Earned

1	Briefly explain the following terms:
	  a) Spectral Reflectance
	  b) Spatial resolution
	  c) Image enhancement
	  d) Radiometric calibration
	  e) Normalization of hyperspectral imagery
		10	

2	a) What is a high-pass filter used for? b) What is a principal component analysis (PCA) used for? c) Explain the main differences between the TM sensor on the LANDSAT and the HRV sensor onboard the SPOT satellite.	3 3 4	
3	a) What are the major steps for the thematic classification of satellite imagery? b) What is the meaning of _training the classifier_? c) What are the major differences between _supervised and unsupervised training of the classifiers_? d) What is the main difference between parametric and nonparametric thematic classification of remote sensing data?	5 3 3 4	

4	a) Briefly explain the following terms:
	  1. Registration
	  2. Rectification
	  3. Geocoding
	  4. Orthorectification
	
	b) Briefly describe the necessary steps and needed information for rectifying a SPOT image.
		5
		
		5	

5	What are the uses of:
	  a) Spectral band ratios?
	  b) The tassled-cap transform?
		2.5
		2.5	

6	Briefly explain the following terms:
	   a) Principal point
	   b) Base-height ratio
	   c) Collinearity condition
	   d) Coplanarity condition
		10	

7	The average elevation of a vertical photograph is 300 m above mean sea level and its scale is 1 mm = 15 m. How high above mean sea level was the aircraft flying when taking the photograph with a 210-mm focal length camera?	5	
8	A tower was identified on a "perfectly" vertical photograph and the distance between its top and its bottom was measured to be 14.3 mm and the distance from the photo centre to the top of the tower was measured to be 85.6 mm. If the scale of the photograph is 1:10,000 and the focal length used to take this photograph is 152.4 mm, how tall is the tower?	5	
9	For the following rotation matrix (M): $$M = \begin{bmatrix} m_{11} & m_{12} & m_{13} \\ m_{21} & m_{22} & m_{23} \\ m_{31} & m_{32} & m_{33} \end{bmatrix}$$ $$= \begin{bmatrix} \cos\phi\cos k + \sin\phi\sin w\sin k & \cos w\sin k & -\sin\phi\cos k + \cos\phi\sin w\sin k \\ -\cos\phi\sin k + \sin\phi\sin w\cos k & \cos w\cos k & \sin\phi\sin k + \cos\phi\sin w\cos k \\ \sin\phi\cos w & -\sin w & \cos\phi\cos w \end{bmatrix}$$ What will be the form of the collinearity equations (below) if the rotation angles ω and ϕ are very small angles (i.e. $< 3°$)? $$\left. \begin{aligned} x_a &= -f \cdot \frac{\left(m_{11}(X_A - X_c) + m_{12}(Y_A - Y_c) + m_{13}(Z_A - Z_c)\right)}{\left(m_{31}(X_A - X_c) + m_{32}(Y_A - Y_c) + m_{33}(Z_A - Z_c)\right)} \\ y_a &= -f \cdot \frac{\left(m_{21}(X_A - X_c) + m_{22}(Y_A - Y_c) + m_{23}(Z_A - Z_c)\right)}{\left(m_{31}(X_A - X_c) + m_{32}(Y_A - Y_c) + m_{33}(Z_A - Z_c)\right)} \end{aligned} \right\}$$	5	
10	What are the main differences between the 2-D affine and 2-D similarity transformations in terms of transformation parameters and quantities needed to estimate these parameters? Tabulate your answer and clearly indicate any assumptions.	5	

11	(a) A pushbroom (linear) digital camera has 1000 array of CCD elements at a pixel size of 10 μm x 10 μm. The nominal focal length of the camera is 25 mm. What is the field of view for this camera? What will be the pixel size on the ground if the flying height is 1000m?	5	
	(b) For a particular photograph, the measured x and y fiducial distances were 233.2 and 233.7 mm. The corresponding x and y-calibrated distances were 232.408 and 232.852 mm, respectively. Compute the corrected values for a point with photo coordinate of x = 102.9 mm and y = -92.1 mm.	5	
12	a) Nowadays, nearly all organizations involved in photogrammetric applications make use of aerial triangulation techniques. Bundle adjustment is one of the most commonly used techniques used in this regard. Explain clearly what is the mathematical model used in bundle adjustment aerial triangulation (i.e. what is the mathematical model being used, parameters being estimated, known and unknown quantities, etc.).	5	
	b) Briefly describe the principle of using integrated GPS and Inertial Navigation Systems for direct geo-referencing photogrammteric data	5	
	Total Marks:	100	0