

**REMOTE SENSING
(AEIE 6134)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Repetitive observations of the same area at equal interval of time are useful to monitor the dynamic phenomena:
(a) cloud evolution (b) vegetative cover
(c) snow cover (d) all of these.
- (ii) In formula $g(x,y) = T[f(x,y)]$, T is the
(a) transformed image (b) transformation vector
(c) transformation theorem (d) transformation function.
- (iii) Which of the following is not a type of image resolution that is very important in image analysis?
(a) spectral (b) energy (c) spatial (d) temporal.
- (iv) A RADAR is
(a) a sensor (b) a transducer (c) an amplifier (d) a filter.
- (v) If θ is the angle of scan measured from the nadir, the ground distance swept by the sensor IFOV is proportional to
(a) $\sin 2\theta$ (b) $\cos 2\theta$ (c) $\sec 2\theta$ (d) $\tan 2\theta$.
- (vi) What is the most common wavelength band which electro-optical scanners work within?
(a) 0.3 and 0.9 μm (b) 0.3 and 14 μm
(c) 0.9 and 14 μm (d) 0.9 and 14 μm .
- (vii) In the process of image classification, which of the following methods results in a greater accuracy of classes within an image actually matching land use patterns on the ground?
(a) unprocessed image interpretation (b) fully automated
(c) manual/supervised by a user (d) robotic classification.

- (viii) Which of the following types of sensors uses a highly focused beam of light?
(a) lidar (b) ground penetrating radar
(c) side-looking radar (d) sonar.
- (ix) If the flying height of a space craft is H , the length of air base is B and the parallax difference between two points is dp , then the difference in height:
(a) $h = dp / (B / H)$ (b) $h = (B / H) / dp$
(c) $h = dp / (H / B)$ (d) $h = (H / B) dp$
- (x) Due to perturbation of the orbit, satellite orbit parameters are frequently updated on measurements carried out by its
(a) five ground stations (b) six ground stations
(c) seven ground stations (d) eight ground stations

Group - B

- 2.(a) What is the fundamental basis of remote sensing system? State the basic components of an ideal remote sensing system.
(b) What are passive and active sensors for remote sensing?
(c) Define the four major sensor resolutions associated with a remote sensing system.
4+ 2+ 6=12
3. (a) What is atmospheric absorption and atmospheric windows?
(b) What is Rayleigh scattering? Why sky appears red during sunset?
(c) Describe energy matter interactions in the atmosphere. What is spectral signature?
3+ 4 + 5=12

Group - C

- 4.(a) Discuss the method of measuring height of an object based on relief displacement.
(b) How length of an object can be measured from its shadow?
(c) For the measurement of height of a tower let the relief displacement for the tower is 3.05mm and the radial distance from the centre of the photo to the top of the tower is 65.58mm. If the flying height is 1200m above the base of the tower, find the height of the tower.
5+2+5= 12
- 5.(a) Discuss the factors that influences the emissivity of an object.
(b) Define thermal inertia and apparent thermal inertia.
(c) The temperature of an object is 1100 K, find out the wavelength at which maximum radiation will be emitted from that object. Drive the radiant temperature of that object. Consider emissivity as 0.9.
4 +4 + 4= 12

Group - D

6. (a) Discuss the major drawback of mean filters and the importance of edge-preserved smoothing filters.
- (b) Calculate the magnitude and direction of the gradient vector at the marked pixel of the given image by using Sobel and Prewitt operators.

$$f(m,n) = \begin{bmatrix} 2 & 1 & 4 & 2 & 5 \\ 5 & 4 & 3 & 4 & 7 \\ 6 & 5 & 7 & 9 & 8 \\ 9 & 8 & 8 & 9 & 10 \\ 9 & 11 & 10 & 11 & 12 \end{bmatrix}$$

- (c) Describe RGB colour model.

3+ 6 + 3 = 12

- 7.(a) What is a point operation in image processing? Give the mathematical definition.

- (b) Derive the output histograms $h_o(y)$ from the input histogram $h_i(x)$ using the following point operation functions:

(i) $y = 3x - 8$

(ii) $y = 2.5x^2 - 3x + 2$

(iii) $y = \sin(x)$

- (c) How is histogram equalization (HE) achieved? How is HE used to achieve histogram matching?

2+ 6 + 4 = 12

Group - E

8. (a) What are minimum distance classifiers?

- (b) A three dimensional measurement $X = \begin{bmatrix} 4 \\ 4 \\ 1 \end{bmatrix}$ is to be classified by means of the

following set of discriminant functions:

$$g_1(X) = x_1 + 0.5x_2 + 2x_3 + 1$$

$$g_2(X) = 2x_1 + x_2 + 0.5x_3$$

$$g_3(X) = 3x_1 + 2x_2 - 4x_3 - 3$$

To which class does X belong?

For class II: $\sim_2 = \begin{bmatrix} 50 \\ 80 \end{bmatrix}$, $\Sigma_1 = \begin{bmatrix} 8 & 0 \\ 0 & 20 \end{bmatrix}$.

Find discriminating functions between the cases considering Mahalanobis distance.

(c) The discriminant functions for a 2-class problem in 2-dimensional space are given by

$$g_1(X) = X_1 + X_2 + 2$$

$$g_2(X) = 2X_1 + 2X_2$$

(i) Write the equation for the decision boundary between the two classes.

(ii) For a pixel $X = [2 \ 2]^T$, find the correct class.

2+ 6 +4 = 12

9. (a) What are the advantages and disadvantages of unsupervised classification? Describe the algorithm for iterative clustering.

(b) What is a confusion matrix? Based on the confusion matrix given below compute overall accuracy, user's accuracy and producer's accuracy and Kappa coefficient.

Predicted Class → / TrueClass ↓	class1	class2	class3	class4	class5
class1	56	9	5	2	8
class2	10	70	7	3	5
class3	0	3	57	10	6
class4	0	6	0	79	4
class5	8	4	3	2	46

(2 + 4) + (2 + 4) = 12

Department	Submission Link
AEIE	https://classroom.google.com/c/MTM4NTY3NzA5Nzkw/a/MjcwOTIxNzk0MzYz/details