Group - E

8. (a) 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?

(b) 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 two pixels $X_1 = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$ and $X_2 = \begin{bmatrix} 1 \\ 0.5 \end{bmatrix}$, find their correct classes.

(c) What are the differences between ANN and SVM?

4 + (2 + 4)+ 2 = 12

9. (a) Suppose in a two-class pattern recognition problem, classes are distributed as Gaussian where mean vectors and covariance matrices are as follows:

For class-I: $\mu_1 = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$, $\Sigma_1 = \begin{bmatrix} 1 & 0 \\ 0 & 3 \end{bmatrix}$

For class-II: $\mu_2 = \begin{bmatrix} 5 \\ 7 \end{bmatrix}$, $\Sigma_2 = \begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$

Determine the class boundary considering Baysian classification scheme. Assume a priori probabilities of class-I and class-II are 0.4 and 0.6 respectively.

(b) For two vectors $X_1 = \begin{bmatrix} 3 \\ 5 \end{bmatrix}$ and $X_2 = \begin{bmatrix} 4 \\ 4 \end{bmatrix}$, find their correct classes using the classifier constructed in problem 9(a).

8 + 4 = 12

REMOTE SENSING
(AEIE 6143)

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) Remote sensing techniques make use of the properties of—–emitted, reflected or diffracted by the sensed objects:
(a) sound waves (b) electromagnetic waves
(c) wind waves (d) electric waves.

(ii) The part radiation due to scattered/diffused radiation entering the field of view of a remote sensor other than that from the required target
(a) increases the contrast of the image but reduces the sharpness
(b) reduces the contrast but increases the sharpness
(c) increases both the contrast and sharpness
(d) reduces the contrast of the image and also its sharpness.

(iii) The most widely used antenna in GPS is
(a) slotted antenna (b) microstrip antenna
(c) parabolid antenna (d) horn antenna.

(iv) Which one of the following errors is produced by platform characteristics of the sensor?
(a) orbit drift (b) altitude variation
(c) altitude (d) all of these.

(v) SAR means:
(a) system aperture radar
(b) synthetic aperture radar
(c) similar aperture radar
(d) synchronizing aperture radar.

(vi) The arrangement of terrain features which provides attributes: the shape, size and texture of objects, is called :
(a) spatial variation (b) spectral variation
(c) temporal variation (d) all of these.

(vii) Histogram is a technique, processed in
(a) intensity domain (b) frequency domain
(c) spatial domain (d) undefined domain.

(viii) The refractive index of the ocean water:
(a) decreases with temperature
(b) increases with temperature
(c) increases with salinity
(d) decreases with salinity.

(ix) Which provides a framework for studying object recognition?
(a) learning (b) unsupervised learning
(c) supervised learning (d) none of the mentioned.

(x) Process of highlighting specific range of intensities is called
(a) pixels slicing (b) colour slicing
(c) Intensity level slicing (d) contrast stretching.

Group - B

2. (a) What is remote sensing? Mention some of its important application areas.

(b) Discuss about the basic components of an ideal remote sensing system and mention how these are affected in case of real remote sensing system.

(c) Explain the key concept of remote sensing by a block diagram.

(1 + 2) + 6 + 3 = 12

3. (a) Discuss about the remote sensing data collection

(b) Define reflectance, transmittance and absorptance.

(c) Differentiate between irradiance and exitance.

6 + 3 + 3 = 12

Group - C

4. (a) What is photogrammitry?

(b) Differentiate between vertical aerial photography and oblique aerial photography.

(c) Assume a vertical photograph was taken at a height of 6000m above sea level using a camera with 152mm focal-length lens.

(i) Determine the photo scale at points A and B which lie at elevations of 1500m and 2400m.

(ii) What will be the ground distances at each of these elevations corresponding to a 28.1mm photo distance?

2 + 2 +(4 + 4) = 12

5. (a) What are azimuth and range directions in any RADAR imaging system? Explain with figure.

(b) Compare slant-range versus ground-range RADAR image geometry.

(c) Two towers are separated by a distance of 15m in the far range with a depression angle of 40° for a real aperture RADAR. If the RADAR uses a pulse train of duration 0.1×10^{-7} sec, determine whether the towers can be resolved or not.

(2 + 2) + 4 + 4 = 12

Group - D

6. (a) Explain the characteristics of the value range of a ratio image. Do you think that two reciprocal ratio images contain the same information when displayed after linear scale and, if so, why?

(b) Using a diagram, describe a ratio image in terms of a coordinate transformation between cartesian and polar coordinates.

(c) Describe image multiplication and its main application.

4 + 4 + 4 = 12

7. (a) Describe the mathematical definitions of image gradient and Laplacian together with examples of gradient and Laplacian filters.

(b) What is the convolution theorem and why is it important in digital image filtering?

(c) Describe the steps of the FFT frequency-adaptive filtering procedure.

3 + 4 + 5 = 12