

**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) The basic requirement of any remote sensing sensor system is
    - (a) radiometric resolution
    - (b) spatial resolution
    - (c) spectral resolution
    - (d) all of these.
  - (ii) The point vertically below the observer on the earth surface is called
    - (a) nadir
    - (b) zenith
    - (c) principal point
    - (d) celestial point.
  - (iii) Which type of remote sensing uses its own source of electromagnetic energy?
    - (a) Passive
    - (b) Active
    - (c) Satellite
    - (d) Orbital.
  - (iv) The observations made over the same area on different dates to monitor change detection is called
    - (a) spatial resolution
    - (b) spectral resolution
    - (c) temporal resolution
    - (d) radiometric resolution.
  - (v) The infrared portion of EMR lies between
    - (a) 0.4 – 0.7  $\mu\text{m}$
    - (b) 0.5 – 1.0  $\mu\text{m}$
    - (c) 0.7 – 1.3  $\mu\text{m}$
    - (d) 0.7 – 14  $\mu\text{m}$ .
  - (vi) A perfectly black body
    - (a) is a diffuse emitter
    - (b) absorbs all the radiations of every wave lengths
    - (c) emits power of every wave length
    - (d) all the above.
  - (vii) Which of the following is not a classification of scattering principle?
    - (a) Faraday scattering
    - (b) Rayleigh scattering
    - (c) Mie scattering
    - (d) Non-selective scattering.
  - (viii) Which one of the following helps to identify objects on the earth surface?
    - (a) Atmospheric window
    - (b) Signature
    - (c) Radiometric error
    - (d) None of these.

- (ix) Vertical photograph coincides with the\_\_\_\_\_
- |                                |                           |
|--------------------------------|---------------------------|
| (a) direction of line of sight | (b) direction of lens     |
| (c) direction of aperture      | (d) direction of gravity. |
- (x) Vegetation with more chlorophyll will reflect more
- |                        |                       |
|------------------------|-----------------------|
| (a) Ultraviolet energy | (b) Emitted energy    |
| (c) Near-infrared      | (d) Thermal infrared. |

### Group - B

2. (a) Outline remote sensing data collection process. [(CO1)(Remember/LOCQ)]  
(b) Identify the problems of in situ data collection processing of remote sensing system. [(CO1)(Analyse/IOCQ)]  
(c) Categorize different types of resolutions considered for remote sensing sensors. [(CO1)(Understand/LOCQ)]  
**4 + 3 + 5 = 12**
3. (a) Discuss different types of atmospheric scattering in brief. [(CO1)(Remember/LOCQ)]  
(b) What is atmospheric absorption and atmospheric windows? [(CO1)(Understand/LOCQ)]  
(c) Calculate the frequency and amount of radiant energy for the wavelength of 1 mm. Consider the speed of light as  $3 \times 10^8$  m/s, and Plank 's constant as  $6.626 \times 10^{-34}$  JS. [(CO1)(Analyse/IOCQ)]  
**4 + 4 + 4 = 12**

### Group - C

4. (a) What are the important measurements that can be performed with vertical aerial photography? Describe the process of area measurement of irregular shape. [(CO3)(Understand/LOCQ)]  
(b) Explain Wein's displacement law. Considering Sun as blackbody of 6000 K, calculate the dominant wavelength emitted from it. [(CO2)(Analyse/IOCQ)]  
(c) Justify the need of synthetic aperture radar to overcome the drawback of real aperture radar and explain its working principle. [(CO2)(Evaluate/HOCQ)]  
**(2 + 2) + 4 + 4 = 12**
5. (a) Define depression angle, incident angle and polarization of electromagnetic wave associated with a RADAR system. [(CO2)(Understand/LOCQ)]  
(b) What is the principle of synthetic aperture radar (SAR)? [(CO2)(Remember/LOCQ)]  
(c) A SLAR system has a 3 millirad antenna beam width. Calculate the azimuth resolution of the system at a range of 10 and 20 km. If the system sends pulses at an interval of 0.2  $\mu$ sec then what will be the slant range and ground resolution at a dispersion angle of 60°. [(CO2)(Evaluate/HOCQ)]  
**3 + 4 + 5 = 12**

**Group - D**

6. (a) What is a low-pass filter for digital image filtering and what are its effects? Give some examples of low-pass filter kernels. Discuss the major drawback of mean filters and the importance of edge-preserved smoothing filters. [(CO4)(Understand/LOCQ)]
- (b) What is the effect of a median filter applied to an image? Find the  $3 \times 3$  median filter output of the following image with zero padding.

$$\begin{bmatrix} 1 & 8 & 6 & 6 \\ 6 & 3 & 11 & 8 \\ 8 & 8 & 9 & 10 \\ 9 & 10 & 10 & 7 \end{bmatrix}$$

[(CO4)(Evaluate/LOCQ)]

- (c) What is an edge-sharpening filter? What are the major applications of edge-sharpening filters? [(CO5)(Understand/LOCQ)]

**4 + 5 + 3 = 12**

7. (a) Describe image multiplication and its main application. [(CO4)(Remember/LOCQ)]
- (b) List the points under what circumstances radiometric and atmospheric corrections of remotely sensed image are required. [(CO5)(Remember/LOCQ)]
- (c) Using a diagram, explain the principle of PCA. Discuss the data characteristics of PC images and their applications. [(CO5)(Analyse/IOCQ)]

**3 + 3 + 6 = 12****Group - E**

8. (a) Use K Means clustering to cluster the following data into two groups. Assume cluster centroid are  $m_1=2$  and  $m_2=4$ . The distance function used is Euclidean distance.  $\{ 2, 4, 10, 12, 3, 20, 30, 11, 25 \}$  [(CO6)(Evaluate/HOCQ)]
- (b) Describe the significance of Kernel functions in SVM. List any two kernel functions. [(CO6)(Understand/LOCQ)]
- (c) Calculate the output  $y$  of a three input neuron with bias. The input feature vector is  $(x_1, x_2, x_3) = (0.8, 0.6, 0.4)$  and weight values are  $[w_1, w_2, w_3, b] = [0.2, 0.1, -0.3, 0.35]$ . Use binary Sigmoid function as activation function. [(CO6)(Evaluate/HOCQ)]
- 4 + 4 + 4 = 12**
9. (a) What are supervised and unsupervised classification? Describe the general steps of supervised classification. [(CO6)(Remember/LOCQ)]
- (b) What is KNN classifier? Explain with examples. [(CO6)(Understand/Analyse/LOCQ)]
- (c) State the advantages and disadvantages of KNN classifier. [(CO6)(Remember/LOCQ)]
- (2 + 2) + 4 + 4 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	64.58%	17.71%	17.71%

**Course Outcome (CO):**

After the completion of the course students will be able to:

1. Understand and describe the key theoretical components involved in the remote sensing data collection process such as, energy sources, energy-terrain-atmosphere interactions, platforms and sensor resolution characteristics spanning multispectral and hyperspectral.
2. Gain knowledge of thermal remote sensing, active microwave remote sensing such as RADAR, LIDAR and synthetic aperture RADAR.
3. Perform photogrammetric calculations such as scale factor, height, area, etc. from vertical aerial photographs.
4. Learn essential image processing techniques such as image enhancement, restoration and filtering of noise, etc.
5. Carry-out basic arithmetic operations and correction procedures such as geometric, radiometric and atmospheric corrections on image.
6. Acquire knowledge of machine learning techniques of remote sensing data analysis.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question