

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 spectral region of the electromagnetic radiation which passes through the atmosphere without much attenuation is known as:
(a) ozone hole (b) ozone window
(c) atmospheric window (d) black hole
- (ii) Which of the following is the definition of 'parallax'?
(a) The fading, disturbance or degradation of a signal from surface reflectance caused by signals from unwanted sources
(b) A mathematical method for fitting a model to data so as to minimize error between the observed values and the estimated values
(c) The apparent change in position of an object when viewed from two different positions
(d) The area on the ground covered by the remote sensing instrument.
- (iii) A and B are two towers of equal height diametrically opposite on either side of the nadir point, at 3km and 5km distances. Which one of the following statements is correct?
(a) height displacement of A will be less than that of B
(b) height displacement of B will be less than that of A
(c) height displacement of A and B is equal
(d) height displacement of A and B will be towards each other
- (iv) Duplexer is
(a) an oscillator (b) a microwave switch
(c) an amplifier (d) an active device
- (v) K-means clustering is a
(a) supervised learning (b) unsupervised learning
(c) semi-supervised learning (d) reinforcement learning

- (vi) The remotely sensed data suffers from error due to the following:
(i) Motion of the earth
(ii) Stability and orbit characteristics of the platform
(iii) Atmospheric effects
(iv) Imaging characteristics of the sensor
Which one of these is correct?
(a) (i) and (ii) (b) (i), (ii) and (iii)
(c) (i), (iii) and (iv) (d) (i), (ii), (iii) and (iv)
- (vii) A 1:50,000 scale map can be compared to the following spatial resolution:
(a) 50000 m (b) 50 m
(c) 1/50000 m (d) not possible to compare
- (viii) 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) $\tan 2\theta$ (d) $\sec 2\theta$
- (ix) The spatial coordinates (x,y) of a digital image are proportional to
(a) position (b) brightness (c) contrast (d) noise
- (x) An image enhancement technique that attempts to improve the contrast in an image by 'stretching' the range of intensity values it contains to span a desired range of values is called?
(a) Non-histogram Equalization (b) Non-linear contrast stretching
(c) Histogram Equalization (d) Linear contrast stretching

Group- B

2. (a) Define remote sensing. Outline the limitations of remote sensing.
[[CO1] (Understand/LOCQ)]
- (b) Compare basic components of ideal remote sensing system with that of real remote sensing components. [[CO1] (Analyze/IOCQ)]
- (c) Justify why remote sensing of the environment is important.
[[CO1] (Evaluate/HOCQ)]
4 + 6 + 2 = 12
3. (a) Discuss the energy matter interactions at the remote sensing study area before it is recorded by the sensor. [[CO1] (Understand/LOCQ)]
- (b) Differentiate between Rayleigh and Mie scattering. [[CO1] (Analyze/IOCQ)]
- (c) Justify the statement that the cumulative effect of absorption by various constituents of atmosphere is bad for remote sensing.
[[CO1] (Evaluate/HOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) Define look direction, near range and far range. [(CO2) (Remember/LOCQ)]
 (b) What is emissivity of a body? If the temperature of the Earth surface is 300 K, what dominant wavelength will be released from earth surface? [(CO2) (Analyze/IOCQ)]
 (c) A given SLAR system has a 1.8-mrad antenna beam width. Determine the azimuth resolution of the system at ranges of 6 and 12 km. [(CO3) (Analyze/IOCQ)]
4 + 2 + 6 = 12
5. (a) Discuss the factors that affects the emissivity of an object and hence thermal infrared remote sensing. [(CO2) (Understand/LOCQ)]
 (b) The temperature of an object is 1100 K, find out the wavelength at which maximum radiation will be emitted from that object. Detect the radiant temperature of that object. Consider emissivity as 0.9. [(CO2) (Evaluate/HOCQ)]
 (c) Assume that the relief displacement for the tower at A is 2.01 mm, and the radial distance from the centre of the photo to the top of the tower is 56.43 mm. If the flying height is 1220 m above the base of the tower, evaluate the height of the tower. [(CO3) (Analyze/IOCQ)]
4 + 3 + 5 = 12

Group - D

6. (a) State the applications of image segmentation in remote sensing and list the different approaches of image segmentation. [(CO4) (Understand/LOCQ)]
 (b) Compute the magnitude and direction of the gradient vector at the marked pixel of the given image by using Sobel and Prewitt operators.

$$f(m,n) = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 3 & 4 & 5 & 6 & 7 \\ 5 & 6 & 7 & 8 & 9 \\ 7 & 8 & 9 & 10 & 11 \\ 9 & 10 & 11 & 12 & 13 \end{bmatrix}$$

- [(CO4) (Analyze/IOCQ)]
 (c) Explain the principles of topographic suppression using the image ratio technique. What is NDVI and how is it designed? [(CO5)(Analyze/IOCQ)]
3 + 6 + 3 = 12
7. (a) Illustrate the colour cube in a diagram and hence show the definition of the grey line in the colour cube. How is a colour composed of RGB components? [(CO4) (Analyze/IOCQ)]

- (b) Assess the k nearest mean filter, median filter and adaptive median filter output using a 3×3 mask placed on the circled pixel on the following image segment and articulate their merits based on the filtering results.

76	78	73
70	40	62
68	63	65

[(CO4) (Evaluate/HOCQ)]

- (c) List the points under what circumstances geometric corrections of remotely sensed image is required. [(CO5)(Understand/LOCQ)]

4 + 6 + 2 = 12

Group - E

8. (a) Describe the method of linear discriminant analysis (LDA). [(CO6) (Evaluate/HOCQ)]
- (b) Elaborate the method of k-means clustering. [(CO6) (Understand/LOCQ)]
- (c) Explain the confusion matrix with respect to machine learning algorithms. What is a false positive and false negative and how are they significant? [(CO6)(Analyse/IOCQ)]
- 4 + 4 + 4 = 12**
9. (a) State the Bays classification rule. [(CO6) (Remember/LOCQ)]
- (b) Illustrate the principle of support vector machine (SVM) classifier. [(CO6) (Analyze/IOCQ)]
- (c) You are given a small data set with just 4 points in 2D-space. Two positive examples, with coordinates (1; 4) and (2; 3); and two negative examples, with coordinates (4; 5) and (5; 6). Find the weight vector w (including the bias term w₀) corresponding to the maximum-margin decision boundary learnt by an SVM on this data set. Give justification/derivation for your answer. Also draw a plot showing the data points (with support vectors circled) and the decision boundary learnt. [(CO6)(Evaluate/HOCQ)]

3 + 4 + 5 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	29%	46%	25%

Course Outcome (CO):

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

- Understand and describe the key theoretical components involved in the remote sensing data collection process such as, energy sources, energy-terrain-atmosphere interactions,

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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

Department & Section	Submission Link
AEIE	https://classroom.google.com/c/NDA1MzYwMTA2NzQw/a/NDYzODcyMjk2NDQ0/details