

## NOTES:-

1. There are 3 sections in this paper. SECTION A is compulsory, while Section B contains two parts out of which only one is to be attempted wholly.
2. There are 55 questions of 85 marks out of which in Section A, there are 15 single answer questions carrying 1 mark question and 20 multiple choice questions carrying 40 marks.
3. In Section B, each PART has 20 questions. 10 question having single answer of 1 mark each and 10 questions having multiple answers carrying 20 marks

## SECTION A

Q. No.	Question
1	Angles $\alpha_1$ , $\alpha_2$ and $\alpha_3$ were measured in the field as $\alpha_1 = 40^\circ 30' 20'' \pm 2''$ , $\alpha_2 = 50^\circ 40' 30'' \pm 3''$ and $\alpha_3 = 10^\circ 40' 50'' \pm 4''$ . The covariances $\sigma_{\alpha_1\alpha_2}$ , $\sigma_{\alpha_2\alpha_3}$ and $\sigma_{\alpha_1\alpha_3}$ have values of $2.0 \text{ sec}^2$ , $3.0 \text{ sec}^2$ , $1.0 \text{ sec}^2$ , respectively. If the two random variables $Y_1$ and $Y_2$ are $Y_1 = \alpha_1 + \alpha_2 + \alpha_3$ and $Y_2 = \alpha_2 + 2\alpha_3$ , the coefficient of correlation between $Y_1$ and $Y_2$ is given as (rounded to two decimal places):
	(A) 0.82
	(B) 0.91
	(C) 0.71
	(D) 0.62
2	A distance of 7.5 km was measured with an electronic distance measuring instrument with an accuracy of $\pm(0.2 \text{ mm} + 0.2 \text{ ppm})$ . The standard error of the measurement (rounded to two decimal places) will be:
	(A) 2.51 mm
	(B) 0.40 mm
	(C) 1.51 mm
	(D) 0.20 mm
3	For the pdf of a random variable $X$ given as: $f(x) = \begin{cases} kx^3; & 0 < x < 1 \\ 0; & \text{elsewhere} \end{cases}$ , the value of $k$ is given as:
	(A) 1
	(B) 2
	(C) 3
	(D) 4
4	In electro-magnetic spectrum, the Thermal Infra-red region lies between-
	(A) 1.00-3.00 $\mu\text{m}$
	(B) 3.00-14.00 $\mu\text{m}$
	(C) 0.42-0.92 $\mu\text{m}$
	(D) 14.00-100.00 $\mu\text{m}$
5	The Instantaneous Field Of View (IFOV) belongs to-
	A. Spatial resolution
	B. Spectral resolution
	C. Radiometric Resolution
	D. Temporal Resolution
6	Hyperspectral images have the advantages of –
	(A) Panchromatic Band
	(B) Easy to analyse

	(C) Does not require any field spectra	(D) Large number of bands in narrow wavelength
7	Which of the following surveying principle is used by GNSS for estimating the location of the GNSS receiver?	
	(A) Resection	(B) Trilateration
	(C) Triangulation	(D) Traversing
8	Among the below, which is/are the wavelength(s) used for GPS operations? 1036.4 MHz (ii) 1575.4 MHz (iii) 1227.6 MHz (iv) 1344.6 MHz	
	ii and iii	i and ii
	iii and iv	ii, iii and iv
9	During the GPS observation DOP values should be:	
	Maximum	Minimum
	Average	Does not matter
10	The process of systematically subdividing a geographic domain using Proximal region is known as	
	(A) Dirichlet tessellation	(B) Thiessen polygon
	(C) Voronoi diagram	(D) Nearest Neighborhood regions
11	Isoclinic lines represent lines of constant	
	(A) salinity	(B) acidity
	(C) magnetic declination	(D) magnetic dip
12	Ordinal Variables have	
	(A) no natural sequence	(B) a natural sequence and the differences between the values quantified
	(C) discrete classes but with an inherent order or sequence	(D) a natural zero or real origin
13	Given histogram of a gray scale image, find the WRONG statement(s)	
	(A) The statistics of the image can be computed from the histogram	(B) The probability of finding a gray level at a random pixel can be estimated from histogram
	(C) The histogram conveys information about sharpness of edges in the image	(D) Entropy of the image can be estimated from the histogram
14	Which of the following resampling algorithm retains the raw pixel values from the original image?	
	(A) Bilinear	(B) Cubic convolution
	(C) Spline	(D) Nearest neighbour
15	Supervised classification methods in remote sensing would essentially require-	
	Prior knowledge of the ground features	Several temporal images
	Selection of homogeneous training sets	Separability analysis
16	A plane triangle having internal angles as $\alpha_1 = 41^\circ 33' 45''$ , $\alpha_2 = 78^\circ 57' 55''$ , and $\alpha_3 = 59^\circ 27' 50''$ with weights of $w_1 = 1$ , $w_2 = 0.67$ and $w_3 = 0.50$ , respectively is to be	

	adjusted by the least squares principle. The <i>a posteriori</i> or reference standard deviation (rounded to one decimal place) after the least squares adjustment will be:	
	(A) 14.2 seconds	(B) 15.0 seconds
	(C) 10.2 seconds	(D) 18.5 seconds
17	While measuring an angle $Z$ , the following uncorrelated observations were obtained. The most probable value of $Z$ (rounded to nearest integer seconds) will be:	
	$Z = 99^{\circ}57'20''$ <i>weight</i> 4 $2Z = 199^{\circ}54'48''$ <i>weight</i> 4 $4Z = 399^{\circ}48'10''$ <i>weight</i> 5	
	(A) $99^{\circ}57'25''$	(B) $99^{\circ}57'7''$
	(C) $99^{\circ}58'14''$	(D) $99^{\circ}58'9''$
18	Visual interpretation of images depends upon–	
	(A) Swath width of images	(B) Quality of images
	(C) Scale of images	(D) Experience of interpreter
19	Supervised classification methods in remote sensing would essentially require–	
	(E) Prior knowledge of the ground features	(F) Several temporal images
	(G) Selection of homogeneous training sets	(H) Separability analysis
20	Calculate the range error $R_E$ when given time offset is $1 \mu s$	
	300m	565m
	108m	400m
21	What is/are the error(s) that cannot be eliminated using differential GNSS technique? (i) Multi path error (ii) ionospheric error (iii) ephemeris errors (iv) tropospheric errors	
	only iv	only i
	(C) only iii	(D) ii and iv
22	Given a correlation matrix and covariance matrix for an $M \times N \times K$ image, $K$ being the dimensionality of the data vectors	
	(A) Both correlation matrix and covariance matrix are always full rank matrices	(B) If the data vectors are zero-mean vectors, covariance matrix and correlation matrix are identical
	(C) In the general case, correlation and covariance both can be zero.	(D) The diagonal elements of the covariance matrix indicate autocorrelation
23	Unsupervised Algorithm Cluster is a	
	Two step process	Iterative method
	Split and merge algorithm	Allows for splitting of clusters
24	Image transformation techniques	
	Generate a new image	Modify the original data set
	Does not generate a new image	None are correct

25	Boolean operators used in GIS overlay analysis use	
	.AND. operator	.OR. operator
	.NOR. operator	None of the operators
26	UAV collects data by	
	(A) Flying at relatively at low altitude	(B) Using a combination of cameras operating in different wavelength region
	(C) uses only B&W camera	(D) Uses a laser beam
27	In trigonometric levelling	
	(A) Vernier theodolite is used	(B) Height of object is found out.
	(C) Use vertical angle to compute the height of object	(D) Only horizontal distance is computed
28	In a levelling equipment, horizontal plane	
	(A) Is a hypothetical surface	(B) Parallel to mean sea level
	(C) Defined by a spirit level	(D) None of the options is correct
29	Stadia wire method is	
	(A) Based on the principle of stadia wires	(B) an approximate method
	(C) Computes both horizontal and vertical distances	(D) accurate for distance upto 30 metres
30	In aerial photographs, the height displacement is	
	(A) directly proportional to Flying height of the aircraft	(B) radial from the principal point
	(C) is maximum along the line joining the corner fiducial mark and the principal point	(D) is inversely proportional to the height of object
31	A GPS NAVISTAR system is	
	(A) Developed by USA	(B) Developed by European Space Agency
	(C) Developed by Russia	(D) Developed by joint venture of USA and Russia
32	The most commonly used method to minimise the effect to error in observation is	
	(A) Average	(B) Weighted Mean
	(C) Mode	(D) Median
33	In GIS, the removal of noise is carried out	
	(A) Statistical approaches	(B) Probabilty approaches
	(C) Fuzzy approaches	(D) None of the above
34	The latest Landsat Mission collects data in	
	(A) 4 bands of the EMR	(B) 8 bands of the EMR
	(C) 11 bands of the EMR	(D) 12 bands of the EMR
35	The Indian GPS system	
	(A) GAGAN	(B) NEELDHARA
	(C) AKASHGANGA	(D) None are correct

## Section B Part 1

1	Which of the following triangle is ill-conditioned and should be avoided in Triangulation surveys	
	Triangle	Interior Angles
	P	90°, 45°, 45°
	Q	135°, 25°, 20°
	R	65°, 90°, 25°
	S	80°, 30°, 70°
	(A) P	(B) Q
	(C) R	(D) S
2	The reduced bearing of a 30 m long line is S30°E. The latitude and departure of the line is	
	(A) 25.98 m, -15.00 m	(B) -25.98 m, 15.00 m
	(C) 15.00 m, 25.98 m	(D) -15.00 m, -25.98 m
3	Optimal flight planning for a photogrammetric survey should be carried out considering following overlap	
	(A) only 75% longitudinal lap	(B) only 35% side lap
	(C) either 75% longitudinal lap or 35% side lap	(D) both 75% longitudinal lap and 35% side lap
4	Digital Elevation Model can be generated using photogrammetry technique from following data	
	(A) Overlapped Aerial Photographs	(B) Stereo satellite images
	(C) GPS ground survey points	(D) All the above
5	An aerial photograph of an area having an average elevation of 1500 m is taken at a scale of 1:5000. The focal length of the camera is 15 cm. The altitude of the flight above mean sea level (in m, in integer) is	
	2150 m	2250.00 m
	2200m	2100 m
6	Which of the following terms is not used in Aerial Photogrammetry?	
	i) Fiducial Marks	
	ii) Parallax	
	iii) Back sighting	
	Swing	
	iv) only	i) only
	iii) only	ii) & iii) only
7	Survey where shape of the Earth is taken into account is called-	
	Plane Survey	Hydrographic Survey
	Geodetic Survey	Cadastral Survey
8	The plan of a map was photo copied to a reduced size such that a line originally 100 mm, measures 90 mm. The original scale of the plan was 1: 1,000. The revised scale of photocopied map is	

	(A) 1 : 900	(B) 1 : 1111
	(C) 1 : 1121	(D) 1 : 1221
9	Which of the following statements is FALSE ?	
	(A) Plumb line is along the direction of gravity	(B) Mean Sea Level (MSL) is a simplification of the Geoid
	(C) Mean Sea Level (MSL) is used as a reference surface for establishing the horizontal control	(D) Geoid is an equipotential surface of gravity
10	The plotting accuracy of a map at 1:15,000 scale is-	
	A. 3.75m	B. 37.50m
	C. 37.50cm	D. 3.75cm
11	Topographical maps produced by Survey of India are available at scale	
	A. 1:1000,000	B. 1:250,000
	C. 1:50,000	D. 1:20,000
12	A Total station was set at point A and following observations were taken to point B. Height of Instrument= 1.35 m, Vertical angle= 45°, Horizontal Distance between A and B=30 m, Height of reflector at point B= 1.20 m Calculation the elevation difference between Point A and B (in m, up to two decimal place)	
	31.5 m	30.5 m
	30.0m	31.0 m
13	The staff reading taken on a room floor using a level is 1.205 m. The inverted staff reading taken to the bottom of a roof is 1.650 m. The reduced level of the floor is 80.505 m. The reduced level (expressed in m) of the bottom of the beam is	
	(A) 80.950 m	(B) 77.650 m
	(C) 83.360 m	(D) 82.155 m
14	The normalized response of the Kirsch operator for the image $\begin{bmatrix} 5 & 1 & 1 \\ 5 & 1 & 1 \\ 5 & 1 & 1 \end{bmatrix}$ is	
	(A) 3	(B) 2
	(C) 4	(D) 5
15	A photo of a tower was taken from an elevation of 1000 m above the datum. The radial distances of the top and bottom of the tower from the principal points are 121.12 mm and 88.82 mm, respectively. If the bottom of the tower is at an elevation 300 m above the datum, then the height (expressed in m, up to two decimal place)) of the tower is	
	200.0 m	20.0 m
	220.0 m	22.0 m
16	An electric pole appears in two successive overlapped photographs. The focal length of the camera is 150 mm and the length of the air base is 100 m. The parallaxes for the top of the pole is 56.70 mm and for the bottom is 54.20 mm, respectively. Find the difference in elevation of top and bottom of the pole.	

	12.20 m	!8.40 m																																																	
	22.20 m	25.50 m																																																	
17	Which of the following geometric errors are accounted for by the first-order polynomial (affine) transformation used in geometric correction: (i) scale (ii) rotation (iii) shear (iv) translation																																																		
	(A) (i), (ii) and (iv)	(B) (ii), (iii) and (iv)																																																	
	(C) (i), (ii), (iii) and (iv)	(D) (i), (ii) and (iii)																																																	
18	The purpose of PCA is																																																		
	reduce the dimensionality (i.e., the number of bands) in the data	compress as much of the information in the original bands into fewer bands																																																	
	Use Gram–Schmidt Sequential Orthogonalization technique to generate uncorrelated dataset	Only option 2 is correct																																																	
19	Given below is raster GIS data set. If central pixel in the dataset is a noise pixel, then the corrected value of this pixel by applying a mean filter of 3×3 is .....																																																		
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	32.5	34.4																																																	
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20	Given below a raster map of wind wind speed with 1= being low wind speed and 3 with moderate wind speed. The direction of wind flow is .....																																																		
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<b>Section B Part 2</b>																																																			
1	The process of digitization converting an analog signal or image into digital form involves:																																																		
	(A) Fourier transform	(B) Integration																																																	
	(C) Sampling	(D) Sampling, Quantization and Coding																																																	

2	<b>Which of the following operations is not linear?</b>		
	(A) Differentiation	<b>(B) Quantization</b>	
	(C) Fourier transform	(D) Z-Transform	
3	An image of size MxN convolved with a filter of size KxL results in an output image of size:		
	(A) M-K x N-L	(B) M+K x N+L	
	(C) (M-K+1) x (N-L+1)	(D) MxN	
4	For an 11-bit/pixel radiometric resolution image, what is the number of cells in the histogram?		
	(A) 11	(B) 256	
	(C) 2047	(D) 2048	
5	A scatter-plot is used for		
	(A) Counting pixels in an image	(B) Understanding correlation between values of one channel with values of another channel	
	(C) Color display of images	(D) Image enhancement	
6	Given a real variance-covariance matrix, which of the following is true		
	(A) Its eigenvalues can be both positive and negative	(B) It is always non-singular	
	(C) Its eigenvectors and mutually orthogonal	(D) Its size depends both on image size and number of bands	
7	Which of the following resampling algorithm retains the raw pixel values from the original image?		
	(A) Bilinear	(B) Cubic convolution	
	(C) Spline	(D) Nearest neighbour	
8	The Laplacian of Gaussian (LoG) filter is applied for		
	(A) image smoothing	(B) logical filtering	
	(C) zero crossings	(D) contrast stretching	
9	The range of minimum ( $L_{min}$ ) and maximum ( $L_{max}$ ) radiance values generally provided in the image header file is used for:		
	(A) inter-conversion between radiance and DN values	(B) supplemental correction	
	(C) contrast stretching	(D) geometric correction	
10	Unsupervised classification requires		
	(A) Does not require prior knowledge of the region	(B) Training data set to classify the image	
	(C) Prior knowledge of the region	(D) None of the answer is correct	
11	Which of the following is not a measure of separability		
	(A) Transformed Divergence	(B) Jeffries – Matusita distance	
	(C) Maximum Likelihood	(D) Bhattacharya distance	
12	Calculate percentage of total variance in the data explained by each principal component calculated for a 3 band multi-spectral remote sensing data		
	Principal Component	1	2



	Eigenvalue, $\lambda_p$	868	149	40
	80.21; 27.05; 0.05	82.11; 14.09; 3.78		
	83.40; 11.06; 2.19	78.61; 30.19; 0.29		
13	Convert RGB multispectral dataset into HIS colour coordinate where R = 109, G = 56, B = 74 values are respectively.			
	(A) 0.811	(B) 0.081		
	(C) 0.008	(d) 0.088		
14	Normalized Difference Vegetation Index (NDVI) is defined as			
	$\frac{RED + NIR}{RED - NIR}$	$\frac{NIR - Green}{NIR + Green}$		
	$\frac{NIR - RED}{RED + NIR}$	$\frac{RED - NIR}{RED + NIR}$		
15	In Intensity(I), Hue (H), and Saturation(S) (IHS) system			
	I represent dominant wavelength; H represents brightness variation and S represents purity of colour	I represent brightness variation; H represents dominant wavelength and S represents purity of colour		
	I represent brightness variation; H represents purity of colour and S dominant wavelength	I represent purity of the colour; H represents brightness variation and S dominant wavelength		
16	Identify the low pass filter kernel			
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 9 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \end{bmatrix}$	$\begin{bmatrix} -1/9 & -1/9 & -1/9 \\ -1/9 & 8/9 & -1/9 \\ -1/9 & -1/9 & -1/9 \end{bmatrix}$
	(a)	(b)	(c)	(d)
	(A)D		(B)C	
	(C)B		(D)A	
17	The Laplacian of Gaussian (LoG) filter is applied for			
	(A) image smoothing	(B) logical filtering		
	(C) zero crossings	(D) contrast stretching		
18	The range of minimum ( $L_{min}$ ) and maximum ( $L_{max}$ ) radiance values generally provided in the image header file is used for:			
	(A) inter-conversion between radiance and DN values	(B) supplemental correction		
	(C) contrast stretching	(D) geometric correction		
19	Image segmentation			
	(A) removes the heterogeneity of amongst a group of pixels.	(B) partitions the image in regular and discrete object		
	(C) Partition the image as per some image properties.	(D) is more suitable for high resolution satellite data.		

20	Region growing	
	(A) is a procedure that groups pixels or sub-regions into larger regions	(B) techniques are better than the edge-based techniques in noisy images.
	(C) is also known as Watershed technique	(D) allows for region growing and splitting