# General Aptitude

## Q.1 – Q.5 Carry ONE mark Each

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| Q.1 | Here are two analogous groups, Group-I and Group-II, that list words in their decreasing order of intensity. Identify the missing word in Group-II.<br>Group-I: Abuse → Insult → Ridicule<br>Group-II: _____ → Praise → Appreciate |
| (A) | Extol |
| (B) | Prize |
| (C) | Appropriate |
| (D) | Espouse |
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| Q.2 | Had I learnt acting as a child, I _____ a famous film star.<br>Select the most appropriate option to complete the above sentence. |
| (A) | will be |
| (B) | can be |
| (C) | am going to be |
| (D) | could have been |
| | |

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| Q.3 | The 12 musical notes are given as $C, C^{\#}, D, D^{\#}, E, F, F^{\#}, G, G^{\#}, A, A^{\#}$, and $B$. Frequency of each note is $\sqrt[12]{2}$ times the frequency of the previous note. If the frequency of the note C is 130.8 Hz, then the ratio of frequencies of notes $F^{\#}$ and $C$ is: |
| (A) | $\sqrt[6]{2}$ |
| (B) | $\sqrt{2}$ |
| (C) | $\sqrt[4]{2}$ |
| (D) | $2$ |
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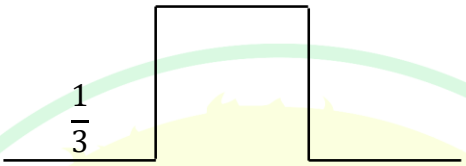
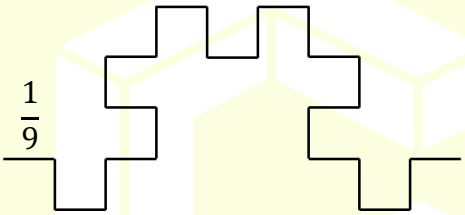
| Q.4 | The following figures show three curves generated using an iterative algorithm. The total length of the curve generated after 'Iteration $n$' is:<br><br>Note: The figures shown are representative. |
| | Iteration 0:  <br>Iteration 1:   Length of each segment: $\frac{1}{3}$<br>Iteration 2:   Length of each segment: $\frac{1}{9}$ |
| (A) | $\left(\frac{5}{3}\right)^{\frac{n}{2}}$ |
| (B) | $\left(\frac{5}{3}\right)^{n}$ |
| (C) | $\left(\frac{5}{3}\right)^{2n}$ |
| (D) | $\left(\frac{5}{3}\right)^{n(2n-1)}$ |
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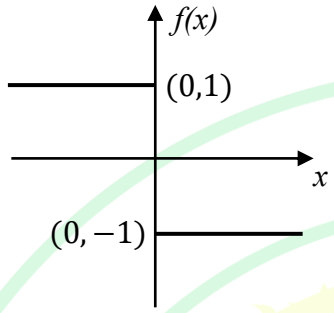
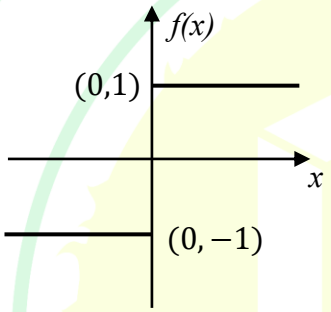
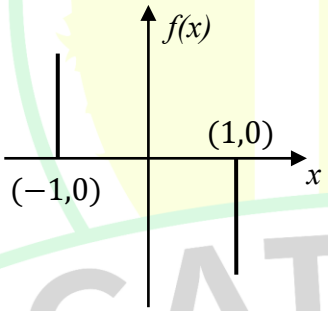
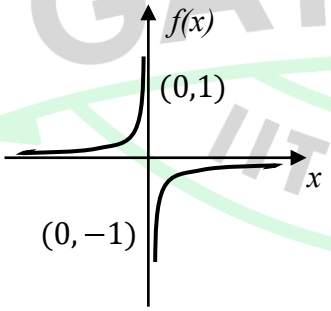
| Q.5 | Which one of the following plots represents $f(x) = -\frac{\lvert x \rvert}{x}$, where $x$ is a non-zero real number?<br>Note: The figures shown are representative. |
| (A) |  |
| (B) |  |
| (C) |  |
| (D) |  |
| | |

**Q.6 – Q.10 Carry TWO marks Each**

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| Q.6 | Identify the option that has the most appropriate sequence such that a coherent paragraph is formed:<br><br>P. Over time, such adaptations lead to significant evolutionary changes with the potential to shape the development of new species.<br><br>Q. In natural world, organisms constantly adapt to their environments in response to challenges and opportunities.<br><br>R. This process of adaptation is driven by the principle of natural selection, where favorable traits increase an organism's chances of survival and reproduction.<br><br>S. As environments change, organisms that can adapt their behavior, structure and physiology to such changes are more likely to survive. |
| (A) | P → Q → R → S |
| (B) | Q → S → R → P |
| (C) | R → S → Q → P |
| (D) | S → P → R → Q |
| | |

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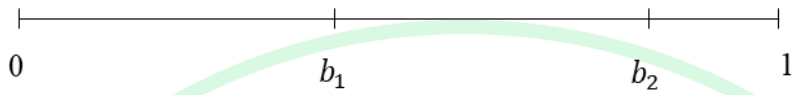
| Q.7 | A stick of length one meter is broken at two locations at distances of $b_1$ and $b_2$ from the origin (0), as shown in the figure. Note that $0 < b_1 < b_2 < 1$. Which one of the following is NOT a necessary condition for forming a triangle using the three pieces?<br><br>Note: All lengths are in meter. The figure shown is representative. |
| |  |
| (A) | $b_1 < 0.5$ |
| (B) | $b_2 > 0.5$ |
| (C) | $b_2 < b_1 + 0.5$ |
| (D) | $b_1 + b_2 < 1$ |
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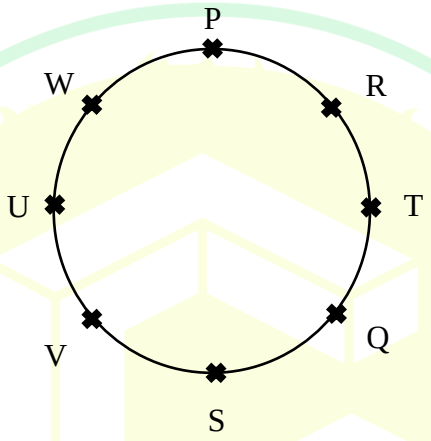
| Q.8 | Eight students (P, Q, R, S, T, U, V, and W) are playing musical chairs. The figure indicates their order of position at the start of the game. They play the game by moving forward in a circle in the clockwise direction.<br><br>After the 1st round, 4th student behind P leaves the game. After 2nd round, 5th student behind Q leaves the game. After 3rd round, 3rd student behind V leaves the game. After 4th round, 4th student behind U leaves the game. Who all are left in the game after the 4th round?<br><br>Note: The figure shown is representative. |
| |  |
| (A) | P; T; Q; S |
| (B) | V; P; T; Q |
| (C) | W; R; Q; V |
| (D) | Q; T; V; W |
| | |

Q.9 The table lists the top 5 nations according to the number of gold medals won in a tournament; also included are the number of silver and the bronze medals won by them. Based only on the data provided in the table, which one of the following statements is INCORRECT?

| Nation | Gold | Silver | Bronze |
|---|---|---|---|
| USA | 40 | 44 | 41 |
| Canada | 39 | 27 | 24 |
| Japan | 20 | 12 | 13 |
| Australia | 17 | 19 | 16 |
| France | 16 | 26 | 22 |

(A) France will occupy the third place if the list were made on the basis of the total number of medals won.

(B) The order of the top two nations will not change even if the list is made on the basis of the total number of medals won.

(C) USA and Canada together have less than 50% of the medals awarded to the nations in the above table.

(D) Canada has won twice as many total medals as Japan.

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| Q.10 | An organization allows its employees to work independently on consultancy projects but charges an overhead on the consulting fee. The overhead is 20% of the consulting fee, if the fee is up to ₹ 5,00,000. For higher fees, the overhead is ₹ 1,00,000 plus 10% of the amount by which the fee exceeds ₹ 5,00,000. The government charges a Goods and Services Tax of 18% on the total amount (the consulting fee plus the overhead). An employee of the organization charges this entire amount, i.e., the consulting fee, overhead, and tax, to the client. If the client cannot pay more than ₹ 10,00,000, what is the maximum consulting fee that the employee can charge? |
| (A) | ₹ 7,01,438 |
| (B) | ₹ 7,24,961 |
| (C) | ₹ 7,51,232 |
| (D) | ₹ 7,75,784 |
| | |

**PART A: Common FOR ALL CANDIDATES**

**Q.11 – Q.27 Carry ONE mark Each**

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| Q.11 | For a sample drawn from normally distributed population, the statistic $Y=\frac{(n-1)s^2}{\sigma^2}$, where $n$ = sample size, $\sigma$ = population standard deviation, $s$ = sample standard deviation, has |
| (A) | Chi-square distribution with $(n-1)$ degrees of freedom |
| (B) | Chi-square distribution with $n$ degrees of freedom |
| (C) | Chi-square distribution with $(n+1)$ degrees of freedom |
| (D) | Gaussian distribution with $n$ degrees of freedom |
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| Q.12 | The reflectance geometry of white-sky albedo can be represented as_____. |
| (A) | bi-directional |
| (B) | bi-conical |
| (C) | bi-hemispherical |
| (D) | directional-conical |
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| Q.13 | Clouds appear white in optical visible spectral bands of remote sensing images due to _____ scattering. |
| (A) | Rayleigh |
| (B) | Mie |
| (C) | selective |
| (D) | non-selective |
| | |
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| Q.14 | If the absolute temperature (greater than 0 K) of a body is doubled, it would emit _____ times more radiation. |
| (A) | 2 |
| (B) | 4 |
| (C) | 8 |
| (D) | 16 |
| | |

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| Q.15 | If the emissivity of an object varies with wavelength, it is called as _____. |
| (A) | grey body |
| (B) | black body |
| (C) | selective radiant |
| (D) | non-selective radiant |
| | |
| | |
| Q.16 | In the context of Global Navigation Satellite System positioning, the Saastamoinen model provides a correction for_____. |
| (A) | zenith hydrostatic delay |
| (B) | slant hydrostatic delay |
| (C) | zenith total delay |
| (D) | slant total delay |
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| Q.17 | In the context of Global Navigation Satellite System positioning, which of the following statement is correct? |
| (A) | In Differential Global Navigation Satellite System, the corrections to the coordinates of the user are transmitted from the reference station |
| (B) | Real-time kinematic positioning and stop-and-go positioning are both kinematic methods |
| (C) | Rapid-static positioning is not a relative positioning technique |
| (D) | Double differencing eliminates the clock errors and improves the noise in the differenced pseudorange observations |
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| Q.18 | In the choke ring antenna there are concentric cylinders placed around the antenna that are of a certain depth to minimize the multipath effect. If the signal wavelength is $\lambda$, then the depth of the cylinders in the choke ring antenna should be |
| (A) | exactly $\frac{\lambda}{4}$ |
| (B) | slightly more than $\frac{\lambda}{4}$ and far less than $\frac{\lambda}{2}$ |
| (C) | exactly $\frac{\lambda}{2}$ |
| (D) | slightly more than $\frac{\lambda}{2}$ and far less than $\lambda$ |
| | |

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| Q.19 | Which one of the following statements is NOT correct in the context of Geographic Information System? |
| (A) | A raster data model makes use of grid of cells that are organized into rows and columns for representation of features on earth |
| (B) | Vector data model represents the spatial features on Earth's surface in terms of points, lines or polygons |
| (C) | Resampling is applied after georeferencing of vector datasets |
| (D) | Topology is used in vector data models to ensure spatial data integrity |
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| Q.20 | Which one of the following statements is NOT correct in the context of shapefile? |
| (A) | It is an example of georelational data model |
| (B) | It is a topological data model |
| (C) | It treats points as pairs of $(x, y)$ coordinates |
| (D) | In this, polygons can have duplicate arcs for shared boundaries |
| | |

Q.21 The table below is an attribute table about employee records. Which attribute can be used as a primary key?

| Employee (Emp_ID) | Name (Emp_Name) | Designation (Emp_Desig) | Department (Emp_Dept) |
|---|---|---|---|
| 100260 | Prashant | Software Developer | Information Technology |
| 100265 | Dinesh | Junior Engineer | Embedded System |
| 100252 | Somya | HR Manager | Management |
| 100271 | Dinesh | Junior Engineer | Information Technology |

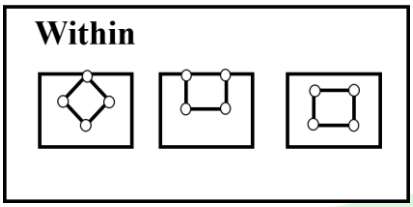
(A) Emp_Name

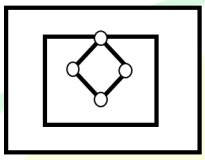
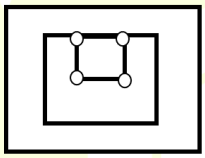
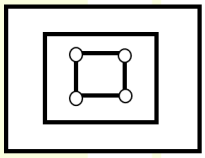
(B) Emp_ID

(C) Emp_Dept

(D) Emp_Desig

Q.22 Find the best match between column I and column II for the following scenario related to spatial operators.




| | Column I | | Column II |
|---|---|---|---|
| P |  | 1 | Within Borders |
| Q |  | 2 | Within Tangent |
| R |  | 3 | Within Strict |

(A) P-2; Q-3; R-1

(B) P-1; Q-3; R-2

(C) P-2; Q-1; R-3

(D) P-1; Q-2; R-3

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| Q.23 | For the weighted least squares adjustment, which of the following statements is/are correct? |
| (A) | Weighted sum of the squares of the residuals is minimized |
| (B) | The expected value of the residuals is equal to zero |
| (C) | Redundancy of observations is maximized |
| (D) | Weights are taken inversely proportional to the variance of the observations |
| | |
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| Q.24 | The geophysical variables that can be measured/derived from the Global Navigation Satellite System observations is/are |
| (A) | ocean color |
| (B) | precipitable water vapor |
| (C) | soil moisture |
| (D) | seismic motion |
| | |
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| Q.25 | For a given set of observations for distance measurements, the standard error was computed as ± 2.5 cm. Assuming that the observations conform to normal error distribution theory, the probable error will be given by ± _____ cm (rounded off to 2 decimal places). |

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| Q.26 | In a two-dimensional coordinate system, it is proposed to determine the size and shape of a triangle ABC in addition to its location and orientation. For this, all the internal angles and sides of the triangle were observed. Further, the planar coordinates of point *A* and bearing/azimuth of line *AB* were known. The redundancy (*r*) for the above system will be equal to _____ (Answer in integer). |
| | |
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| Q.27 | The covariance matrix, Σ, for the planar coordinates of a surveyed point is given as:<br>$\Sigma = \begin{bmatrix} 25\ \text{mm}^2 & 0.500\ \text{mm}^2 \\ 0.500\ \text{mm}^2 & 100\ \text{mm}^2 \end{bmatrix}$<br>The coefficient of correlation is_____ (rounded off to 2 decimal places). |
| | |

**Q.28 – Q.46 Carry TWO marks Each**

<table>
<tr><td>Q.28</td><td>Match the following SAR sensors to their frequency bands</td></tr>
<tr><td></td><td>
<table>
<tr><th colspan="2">Column -I</th><th></th><th colspan="2">Column - II</th></tr>
<tr><td>P</td><td>NOVASAR</td><td></td><td>1</td><td>X – BAND</td></tr>
<tr><td>Q</td><td>RISAT-1</td><td></td><td>2</td><td>C – BAND</td></tr>
<tr><td>R</td><td>TERRASAR</td><td></td><td>3</td><td>L – BAND</td></tr>
<tr><td>S</td><td>ALOS PALSAR</td><td></td><td>4</td><td>S – BAND</td></tr>
</table>
</td></tr>
<tr><td>(A)</td><td>P – 3, Q – 2, R – 4, S – 1</td></tr>
<tr><td>(B)</td><td>P – 4, Q – 2, R – 1, S – 3</td></tr>
<tr><td>(C)</td><td>P – 2, Q – 4, R – 1, S – 3</td></tr>
<tr><td>(D)</td><td>P – 1, Q – 4, R – 3, S – 2</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Q.29</td><td>The relativistic effect in Global Navigation Satellite System satellites has two parts, of which the first part is the time dilation due to the shift in the fundamental frequency of the satellite clock. The second part is due to the satellite’s semi-major axis and _____.</td></tr>
<tr><td>(A)</td><td>eccentricity</td></tr>
<tr><td>(B)</td><td>inclination</td></tr>
<tr><td>(C)</td><td>argument of perigee</td></tr>
<tr><td>(D)</td><td>right ascension of the ascending node</td></tr>
<tr><td></td><td></td></tr>
</table>

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| Q.30 | A country has 7 permanent Global Navigation Satellite System stations covering its territory. Their surveying organization generates a network solution after applying double differencing to the observations. These 7 permanent stations can view 5 to 10 common satellites at any given epoch. What is the range (minimum, maximum) of the number of independent double differenced observables possible? |
| (A) | (35, 70) |
| (B) | (30, 56) |
| (C) | (28, 48) |
| (D) | (24, 54) |
| | |

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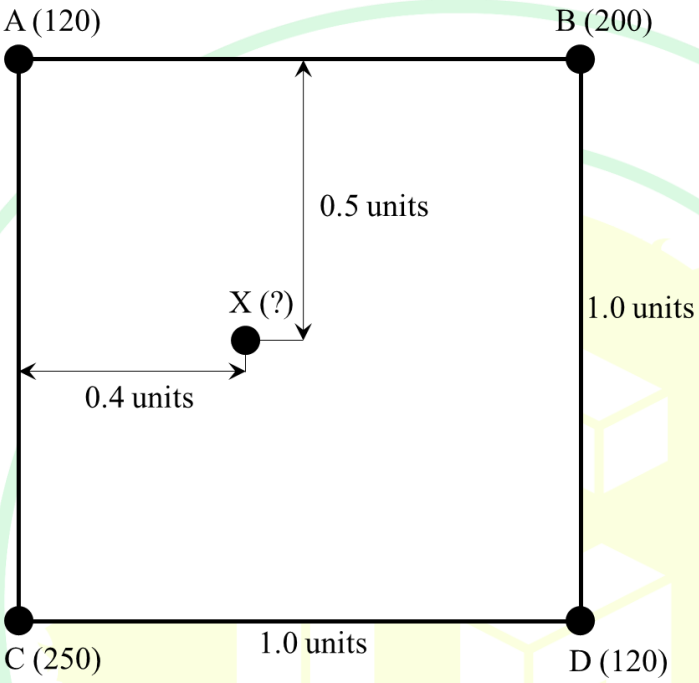
| Q.31 | Consider the nodes of a square grid A, B, C and D (shown in figure below), where a certain parameter is measured. The distances between the points is also indicated in the same figure. For example, the value observed at point A is 120 and is indicated as A (120), and the distance between points A and B is 1.0 units. The value at point 'X' computed using bilinear interpolation, using the values at points A, B, C and D is _____. |
| |  |
| (A) | 175 |
| (B) | 152 |
| (C) | 198 |
| (D) | 210 |

Q.32 The first value in the output of a SQL query (given below) when run on a table having name “Table-1”is?

SQL Query: SELECT LastName FROM Table-1 WHERE State=“IN” ORDER BY FirstName

Table-1

| LastName | FirstName | StreetNumber | StreetName | City | State |
|---|---|---|---|---|---|
| Squires | Edwin | 4589 | Shamar Rd. | Upland | IN |
| Rothrock | Paul | 91657 | Carex Ave. | Upland | IN |
| Ramirez | Douglas | 123 | Fake St. | Springfield | IN |
| Peterson | Chris | 4687 | Windthrow Way | Kane | PA |
| Gibson | David | 354 | Bluestem St. | Carbondale | IL |

(A) Ramirez

(B) Douglas

(C) Paul

(D) Squires

| | |
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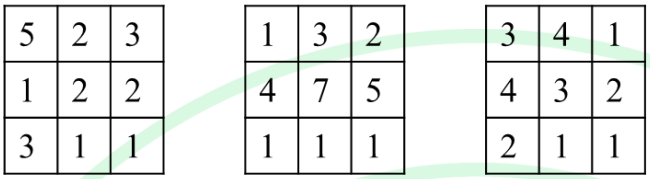
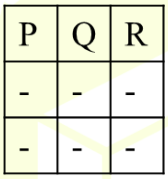
| Q.33 | Consider the three input raster images given below. A geospatial analyst decided to use the overlay operation to generate a new raster showing the average values. The values of the cells P, Q and R in the output raster are: |
| | Input raster<br>  <br>Output raster<br>  |
| (A) | P = 3, Q = 3, R = 2 |
| (B) | P = 4, Q = 4, R = 3 |
| (C) | P = 3, Q = 3, R = 3 |
| (D) | P = 4, Q = 4, R = 2 |

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| Q. 34 | In a Geographic Information System database, a stream is represented by a line and houses are represented by polygons. The pollution in the stream is affecting houses within a distance of 500 m on both sides. Which vector data analysis operations should be performed to identify houses affected by the pollution in the stream? |
| (A) | Buffer and Overlay |
| (B) | Dissolve and Overlay |
| (C) | Buffer |
| (D) | Split |

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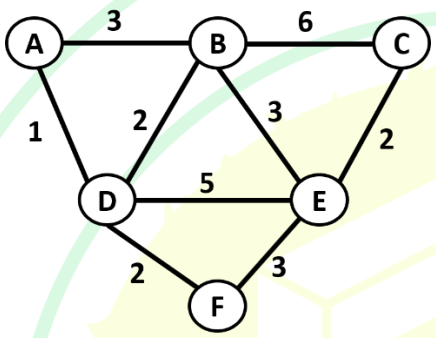
| Q.35 | In a given weighted graph shown below, what is the value of the expression $(p+d)^2$<br><br>where,<br><br>i. Alphabets A, B, C, D, E and F denote the nodes<br>ii. Numbers 1 to 6 denote the weights between two nodes<br>iii. $d$ = shortest distance between node A and node E<br>iv. $p$ = number of paths with distance $d$ |
| |  |
| (A) | 100 |
| (B) | 64 |
| (C) | 81 |
| (D) | 121 |

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| Q.36 | In a plane triangle, the observed angles $P$, $Q$ and $R$, assumed uncorrelated, with given weights are:<br>$P$ = 40°19′02″ weight = 1<br>$Q$ = 70°30′01″ weight = 2<br>$R$ = 69°11′00″ weight = 1<br>The most probable values of these angles $(\hat{P}, \hat{Q}, \hat{R})$ will be given by: |
| (A) | $\hat{P}$ = 40°19′00″, $\hat{Q}$ = 70°30′00″, $\hat{R}$ = 69°11′00″ |
| (B) | $\hat{P}$ = 40°19′01″, $\hat{Q}$ = 70°30′00″, $\hat{R}$ = 69°10′59″ |
| (C) | $\hat{P}$ = 40°19′0.8″, $\hat{Q}$ = 70°30′0.4″, $\hat{R}$ = 69°10′58.8″ |
| (D) | $\hat{P}$ = 40°18′58.4″, $\hat{Q}$ = 70°30′0.4″, $\hat{R}$ = 69°11′1.2″ |
| | |
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| Q.37 | Which of the following statements is/are correct in the context of Voronoi polygon? |
| (A) | A Voronoi polygon may contain more than one point, especially where the density of points is higher |
| (B) | The center of a Voronoi polygon is a circumcenter of a Delaunay triangle |
| (C) | Each intersection of Voronoi edges belongs to at least three Voronoi polygons |
| (D) | Voronoi polygons and Delaunay triangles are geometric dual of each other |

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| Q.38 | Which of the following conditions is/are essential for geostationary satellite orbits? |
| (A) | Eccentricity is zero |
| (B) | Inclination is close to zero |
| (C) | Prograde |
| (D) | Retrograde |
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| Q.39 | Two adjacent angles $A$ and $B$ have been observed with the following mean values and correlation matrix, $\rho$:<br>$\left.\begin{matrix}\bar{A} = 10°20'10'' \pm 10'') \\ \bar{B} = 25°35'15'' \pm 20'')\end{matrix}\right\}$ $\rho = \begin{bmatrix}1.0 & 0.6 \\ 0.6 & 1.0\end{bmatrix}$<br>The standard deviation of the sum of the estimated angles $\bar{A}$ and $\bar{B}$ will be _____ (in arcseconds) (rounded off to 2 decimal places). |
| | |
| | |
| Q.40 | The residual error in a measurement comprises a bias of + 0.08 m and a random component given by the following density function:<br>$f(x) = \frac{1}{0.15}\exp\left(\frac{-x^2}{0.0072}\right)$ $m^{-1}$<br>For this system, the mean square error (MSE) is _____ m. (rounded off to 2 decimal places) |

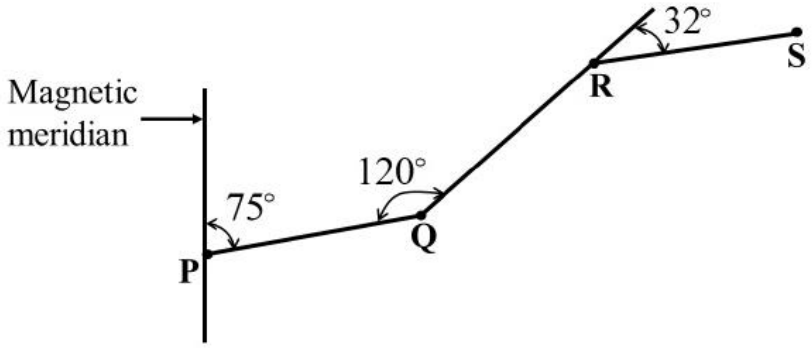
| | |
|---|---|
| Q.41 | For the following ten angle observations, the standard error of the mean angle is given as _____ arcsecond (rounded off to 2 decimal places).<br>$25°40'12''$ $25°40'14''$ $25°40'16''$ $25°40'18''$ $25°40'09''$<br>$25°40'15''$ $25°40'10''$ $25°40'13''$ $25°40'15''$ $25°40'18''$ |
| | |
| | |
| Q.42 | The velocity ($V_s$) of a satellite moving in a circular orbit at a height of 1000 km above earth surface is _____ km $s^{-1}$ (rounded off to 2 decimal places).<br>($G = 6.67\times10^{-11}$ $m^3$ $kg^{-1}$ $s^{-2}$, $M_e = 5.972\times10^{24}$ kg and $r_e = 6378$ km) |
| | |
| | |
| Q.43 | If the radiant temperature of a body is 360 K and its emissivity 0.6, then the kinetic temperature of that body is _____ K (Answer in integer). |
| | |
| | |
| Q.44 | Energy carried by a part of short-wave infrared ray at 1000 nm wavelength is _____ eV (rounded off to 2 decimal places).<br>$h = 6.626\times10^{-34}$ J s , 1 J = $6.242\times10^{18}$ eV, c= $3\times10^8$ m $s^{-1}$ |
| | |

| | |
|---|---|
| Q.45 | The scattering matrix for a fully polarimetric synthetic aperture radar pixel is given below. The $C_{11}$ element of the covariance matrix computed with a 1 × 1 window will be ____? (rounded off to 2 decimal places).<br><br>Here, $i = \sqrt{-1}$. |
| | $\begin{bmatrix} 0.1+0.5i & 0.1-0.1i \\ 0.1+0.1i & 0.3-0.5i \end{bmatrix}$ |
| | |
| | |
| Q.46 | Global Navigation Satellite System can be used for positioning and timing. The average geometric dilution of precision (GDOP) at a location is 1.0 and positional dilution of precision (PDOP) is 0.8. With the precision of the measurements being 300 m, the achieved precision of timing is ____ns (Answer in integer).<br><br>Consider the speed of light is $3\times10^{8}$ m s$^{-1}$ |
| | |

**PART B: FOR Section I: Surveying and Mapping CANDIDATES ONLY**

**Q.47 – Q.54 Carry ONE mark Each**

| | |
|---|---|
| Q.47 | Two positions on the Earth's surface are given in the form of Cartesian coordinates in the WGS84 reference frame and ellipsoid. The norm of difference of these two position vectors is the_____. |
| (A) | spherical distance |
| (B) | ellipsoidal distance |
| (C) | Euclidean distance |
| (D) | planar distance |
| | |
| | |
| Q.48 | Which one of the following map projections is NOT conformal? |
| (A) | Transverse Mercator |
| (B) | Stereographic |
| (C) | Lambert Conformal Conic |
| (D) | Sinusoidal |

| | |
|---|---|
| Q.49 | In a Survey of India topographic map of scale 1:50,000, the contours are drawn conventionally at intervals of _____ m. |
| (A) | 10 and 20 |
| (B) | 20 and 40 |
| (C) | 30 and 50 |
| (D) | 25 and 50 |
| | |
| | |
| Q.50 | Figure below shows an open traverse PQRS, where P is the starting point of traverse and S is the end point of traverse. Which one of the following is correct? |
| |  |
| (A) | $\angle R$ = Bearing = 32°, $\angle P$ = Deflection Angle = 75°, $\angle Q$ = Included Angle = 120° |
| (B) | $\angle P$ = Bearing = 75°, $\angle Q$ = Deflection Angle = 120°, $\angle R$ = Included Angle = 32° |
| (C) | $\angle P$ = Bearing = 75°, $\angle R$ = Deflection Angle = 32°, $\angle Q$ = Included Angle = 120° |
| (D) | $\angle R$ = Bearing = 32°, $\angle Q$ = Deflection Angle = 120°, $\angle P$ = Included Angle = 75° |

| | |
|---|---|
| Q.51 | When conducting a survey using a total station, a zenith angle is measured as 84°13′56″ in the direct mode. What is the equivalent zenith angle in the reverse mode? |
| (A) | 264°13′56″ |
| (B) | 05°46′04″ |
| (C) | 275°46′04″ |
| (D) | 185°46′04″ |
| | |
| | |
| Q.52 | In a closed traverse PQRST the following data were collected in the field. What is the correct sum of deflection angles for this traverse? |
| | <table><tr><th>Line</th><th>Length (m)</th><th>Bearing</th></tr><tr><td>PQ</td><td>201.54</td><td>62°42′</td></tr><tr><td>QR</td><td>189.68</td><td>154°54′</td></tr><tr><td>RS</td><td>231.94</td><td>202°32′</td></tr><tr><td>ST</td><td>272.55</td><td>281°44′</td></tr><tr><td>TP</td><td>256.83</td><td>22°00′</td></tr></table> |
| (A) | 382°00′ |
| (B) | 360°00′ |
| (C) | 540°00′ |
| (D) | 723°52′ |

| | |
|---|---|
| Q.53 | Which one of the following parameters does NOT affect the scale of a vertical aerial photograph? |
| (A) | Size of the photograph |
| (B) | Focal length of the camera |
| (C) | Flying height |
| (D) | Terrain elevation |
| | |
| | |
| Q.54 | Select the correct statement in the context of relief displacement in vertical aerial photographs. |
| (A) | It is zero for principal point, irrespective of whether the point is above or below the datum |
| (B) | It increases with increased flying height above datum |
| (C) | It occurs radially from one of the image corners |
| (D) | It has no effect on the appearance (in the aerial photograph) of the straight roads over an undulating terrain |

**Q.55– Q.65 Carry TWO marks Each**

| | |
|---|---|
| Q.55 | Given $h_P = H_P + N_P$, where $h_P$ is the ellipsoidal/geodetic height at point $P$, $H_P$ is the orthometric height and $N_P$ is the geoid undulation along the ellipsoidal normal. Which one of the following statements is correct? |
| (A) | Two points on the Earth's surface that have the same ellipsoidal height will be on the same equipotential surface |
| (B) | The geoid undulation is the separation of the equipotential surface at the ground surface with respect to the ellipsoid |
| (C) | The points on an equipotential surface will not have the same orthometric height |
| (D) | The orthometric height of the instantaneous sea level is zero |

Q.56 In the figure below, $I_1$ and $I_2$ are the two instrument stations. The instrument stations and the object (P) lie in the same vertical plane. Assume all instruments and staff are levelled.

L = horizontal distance between the object and the station $I_2$

b = horizontal distance between the instrument stations

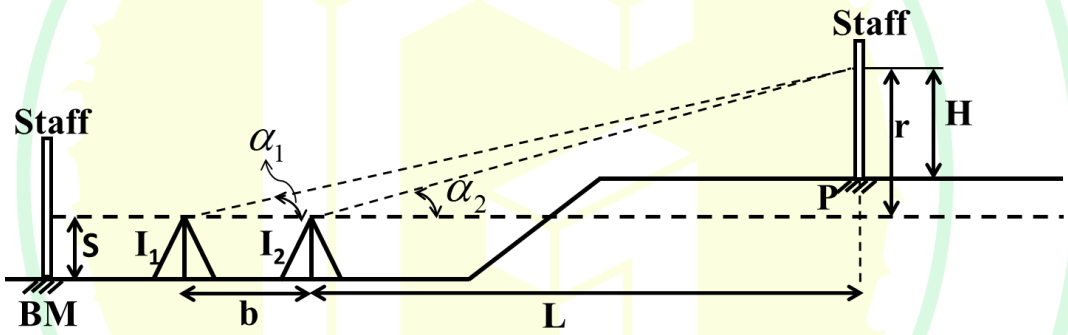
S = staff reading at the Benchmark (BM) for horizontal line of sight

H = reading on the staff at P

r = height of the point sighted by instruments at the staff kept at P from the line of sight of the instruments

$\alpha_1$ and $\alpha_2$ = vertical angles to the reading on staff at P from $I_1$ and $I_2$, respectively

Which one of the following relationships is correct for L?




(A) $L = \left(\frac{b \tan \alpha_1}{\tan \alpha_1 - \tan \alpha_2}\right)$

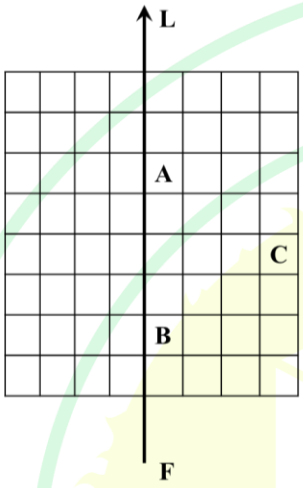
(B) $L = \left(\frac{b \tan \alpha_2}{\tan \alpha_2 - \tan \alpha_1}\right)$

(C) $L = \left(\frac{b \tan \alpha_1}{\tan \alpha_2 - \tan \alpha_1}\right)$

(D) $L = \left(\frac{b \tan \alpha_2}{(\tan \alpha_1 - \tan \alpha_2}\right)$

| | |
|---|---|
| Q.57 | In a closed traversed with five sides, the closing error found from the fore bearing and back bearing of the last line is +0.5°. The correction to the fourth line will be |
| (A) | –0°12′ |
| (B) | 0°18′ |
| (C) | –0°24′ |
| (D) | 0°30′ |
| | |
| | |
| Q.58 | Consider a pair of overlapping vertical aerial photographs taken from a flying height of 665 m above a point A on the ground, with a camera having a focal length of 152.4 mm. The height of the point A above the mean sea level is 535 m. The parallax bar reading of the point A as measured from the photographs is 10.96 mm. Assuming the air base to be 400 m, the parallax bar constant is _____ mm. |
| (A) | 80.71 |
| (B) | 457.96 |
| (C) | 39.84 |
| (D) | 24.18 |
| | |
| | |

| | |
|---|---|
| Q.59 | The statements below show the relationship of Whole Circle Bearing (WCB) with the Quadrantal Bearing (QB) for quadrant designations North-East (N-E), North-West (N-W), South-East (S-E) and South-West (S-W). Which of the following statements is/are correct? |
| (A) | For the quadrant S-W, QB = WCB −180° |
| (B) | For the quadrant S-W, WCB = 180° − QB |
| (C) | For the quadrant N-W, WCB = 180° − QB |
| (D) | For the quadrant N-W, QB = − WCB 360° |
| | |

| | |
|---|---|
| Q.60 | Consider an infinitely sized square grid pattern (as shown in the figure below) overlaid on a flat ground at an elevation of 120 m above mean sea level. An image is taken by a camera from flying height of 450 m above mean sea level. Assume that the flying height remains constant throughout the operation of the flight. The flying direction is along the line FL, as shown in the figure below. The camera is looking in the off-nadir in the flight direction resulting in a low oblique photograph. Which of the following statements for the resulting low oblique photograph is/are correct? |
| |  |
| (A) | Scale of the photograph is not uniform along the flight direction |
| (B) | Parallel lines on the ground do not always appear parallel in the resulting photograph |
| (C) | Horizon is visible in the photograph |
| (D) | Cells A, B and C appear as squares in the resulting aerial photograph |
| | |
| | |
| Q.61 | A point is specified along the Greenwich Meridian at 60° N latitude on an ellipsoid. The parameters of the ellipsoid are semi-major axis $a$=6378137 m and flattening factor $f=\frac{1}{298.224}$. The volume of the ellipsoid is given by $\frac{4\pi a^2 b}{3}$, where $b$ is the semi-minor axis. The latitude of the point on the sphere whose volume is the same as the volume of the ellipsoid of reference is _____° N (rounded off to 2 decimal places). |

| | |
|---|---|
| Q.62 | In a map based on the UTM projection, the grid distance is in error with respect to the geodetic distance by about one in four thousand. If the map distance is 3 cm and the map scale is 1:25,000, then the geodetic distance is_____ m (rounded off to 2 decimal places). |
| | |
| | |
| Q.63 | A level with the height of the instrument being 2.550 m has been placed at a station having a Reduced Level (RL) of 130.565 m. The instrument reads 3.665 m on a levelling staff held inverted at the bottom of a bridge deck. The RL of the bottom of the bridge deck is_____m (rounded off to 3 decimal places). |
| | |
| | |
| Q.64 | In levelling between two points P and Q on opposite banks of a river, the level was set up near P, and the staff reading on P and Q were 2.165 m and 3.810 m, respectively. The level was then moved and set up near Q and the respective staff readings on P and Q were 0.910 m and 2.355 m. The true difference of level between P and Q is_____ m (rounded off to 3 decimal places). |
| | |
| | |
| Q.65 | A 23 cm square format camera with a focal length of 152.4 mm is used for taking vertical aerial photographs with 60% end-lap. These photographs are viewed under a stereoscope with a base-height ratio of 0.15. The vertical exaggeration while stereoviewing these photographs is _____ (Answer in integer). |

**PART B: FOR Section II: Image Processing and Analysis CANDIDATES ONLY**

**Q.66 – Q.73 Carry ONE mark Each**

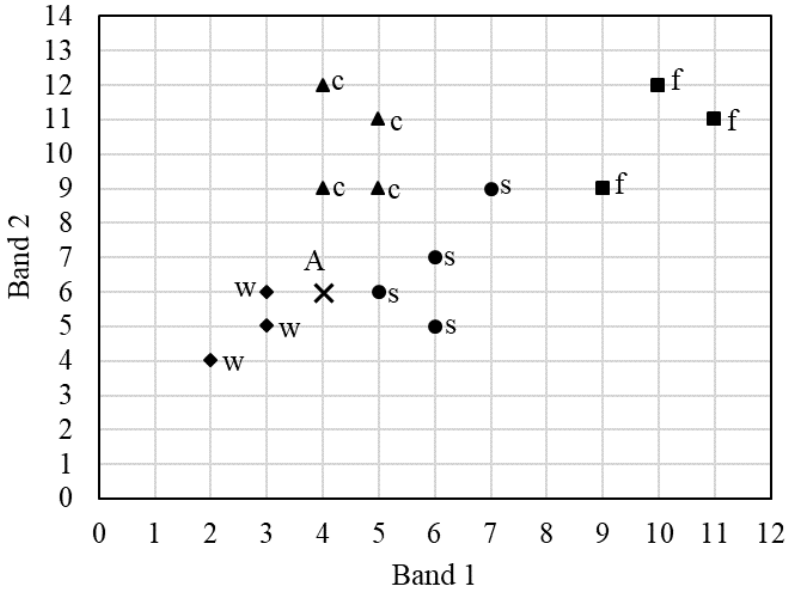
| | |
|---|---|
| Q.66 | Which one of the following image processing methods employs standard deviation? |
| (A) | Band ratio |
| (B) | Parallelepiped classification |
| (C) | Correction of skew distortion in raw satellite image |
| (D) | Nearest neighbor classification |
| | |
| | |
| Q. 67 | Which one of the following is NOT used to assess the quality of remote sensing image? |
| (A) | Univariate statistics of image |
| (B) | Histogram |
| (C) | Multivariate statistics of image |
| (D) | Swath of the image |
| | |
| | |

| | |
|---|---|
| Q.68 | Which one of the following techniques is NOT used to atmospherically correct the satellite image? |
| (A) | Image normalization using histogram adjustment |
| (B) | Radiative transfer model |
| (C) | Image to image registration |
| (D) | Image normalization using regression |
| | |
| | |
| Q.69 | A remote sensing instrument measures only in Green, Red and Near-Infrared frequency bands. The remote sensing index/indices that CANNOT be derived using data of this instrument is/are_____. |
| (A) | Normalized Difference Vegetation Index |
| (B) | Atmospherically Resistant Vegetation Index |
| (C) | Soil Adjusted Vegetation Index |
| (D) | Enhanced Vegetation Index |
| | |
| | |
| Q.70 | Principal Component Analysis is performed on a 4-band IRS satellite image. The eigen values ($E = [\lambda_{1,1}, \lambda_{2,2}, \lambda_{3,3}, \lambda_{4,4}]$) computed from the covariance matrix are $887.60, 75.20, 37.60$ and $6.73$, respectively. The percentage of total variance explained by the third principal component $(\lambda_{3,3})$ is _____ (rounded off to 2 decimal places). |

| | |
|---|---|
| Q.71 | Piecewise linear contrast stretch is performed on an 8-bit image. The output ($BV_{out}$) would be zero for input value $BV_{in} \leq 80$. The output ($BV_{out}$) would be 255 for $BV_{in} > 120$. For the remaining input values, $BV_{out} = (2 \times BV_{in}) - 20$.<br><br>If $BV_{in} = 120$, then $BV_{out}$ is _____ (Answer in integer). |
| | |
| | |
| Q. 72 | A CCD array element in a remote sensing sensor measures incoming radiation and its output voltage varies linearly between 0 V to 5 V. This voltage is converted to an 8-bit digital image using an analogue to digital convertor (ADC). The ADC has a linear response without bias or noise. If the output image pixel has a digital number of 100, the input voltage to the ADC would be _____ V (rounded off to 2 decimal places). |
| | |
| | |
| Q.73 | In supervised digital image classification, the number of combinations to be evaluated to select three best bands out of five bands is_____ (Answer in integer). |
| | |

**Q.74– Q.84 Carry TWO marks Each**

| | |
|---|---|
| Q.74 | The figure below shows a one-dimensional function, $f$, and a filter $w$. Consider $f$ is padded with zeros on both sides. Which one among the following will be the final convolution output of $f$ with $w$ after the padding zeros are removed from the output? |
| | $f$: 0 0 1 0 0<br>$w$: 1 2 3 |
| (A) | 0 0 1 0 0 |
| (B) | 3 2 1 0 0 |
| (C) | 0 0 1 2 3 |
| (D) | 1 2 3 0 0 |
| | |

| | |
|---|---|
| Q.75 | Figure below shows the scatterplot of training pixels of water (w), sand (s), forest (f) and commercial (c) in bands 1 and 2. Pixel 'A' having digital number 4 and 6 in band 1 and band 2, respectively, is to be classified using k-nearest neighbor classifier having the value of k equal to 5. The assigned class for the pixel 'A' is _____. |
| |  |
| (A) | forest |
| (B) | sand |
| (C) | water |
| (D) | commercial |

| | |
|---|---|
| Q.76 | A remote sensing image is acquired from an IRS series satellite. Initially a two-dimensional filter with transfer function $H(u,v) = \exp\left(\frac{-D^2(u,v)}{2D_0^2}\right)$ is applied to reduce scan line effects. Here $D(u,v)$ is the distance from center of the frequency rectangle, and $D_0$ is the cutoff frequency. Which one of the following will be the transfer function for the corresponding filter to detect the edges in the image? |
| (A) | $1 - \exp\left(\frac{-D^2(u,v)}{2D_0^2}\right)$ |
| (B) | $\exp\left(\frac{-D^2(u,v)}{2D_0^2}\right)$ |
| (C) | $1 + \exp\left(\frac{-D^2(u,v)}{2D_0^2}\right)$ |
| (D) | $1 - \exp\left(\frac{D^2(u,v)}{2D_0^2}\right)$ |
| | |
| | |
| Q.77 | Consider an imaging system with 128×128 pixels that produces a noiseless, distortion-free digital image. It is used to digitize checkerboard patterns where all squares of the pattern are in the field of view. Using this imaging system, if a checkerboard pattern with 128×128 squares is digitized, each square will be 1×1 pixel in size. What is the size of the checkerboard square in the generated digital image for which spatial aliasing is observed (measured in pixels of the imaging system)? |
| (A) | 1 |
| (B) | 2 |
| (C) | 0.9 |
| (D) | 2.5 |

Q.78 For the correlation matrix of a 4-band satellite image as shown below, which of the following statements is/are correct?

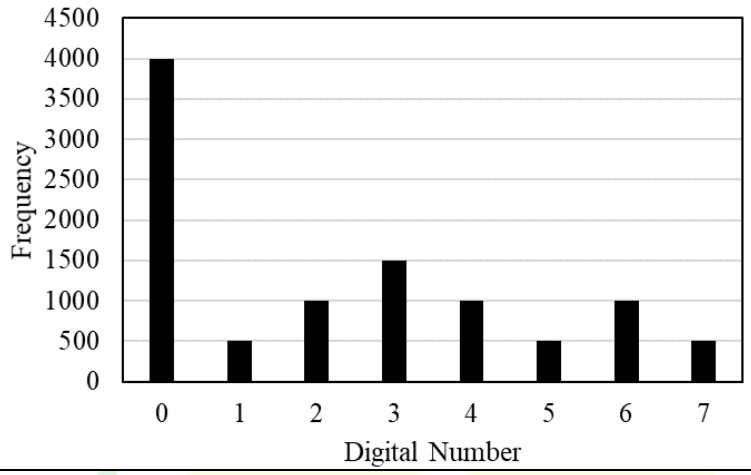
| | Band 1 | Band 2 | Band 3 | Band 4 |
|---|---|---|---|---|
| Band 1 | 1 | 0.95 | 0.36 | 0.92 |
| Band 2 | 0.95 | 1 | 0.40 | 0.93 |
| Band 3 | 0.36 | 0.40 | 1 | 0.42 |
| Band 4 | 0.92 | 0.93 | 0.42 | 1 |

(A) Band 3 provides some unique information not found in other bands

(B) There is high redundancy in band 2 and 4

(C) The standard deviation of all the bands is equal

(D) Image cannot be classified using bands 1 and 3 only

| | |
|---|---|
| Q.79 | The histogram of a red band in a 3-bit satellite image is shown below. Which of the following statements is/are correct? |
| |  |
| (A) | There are more darker pixels in the image |
| (B) | There are more brighter pixels in the image |
| (C) | The mean digital number of the image is 1250 |
| (D) | It may be predicted that approximately 40% of area in the image is covered by material with low spectral albedo in red band |
| | |
| | |
| Q.80 | Which of the following statements is/are correct regarding across-track scanning sensor of an airborne optical imaging system? |
| (A) | The relief displacement will be along the direction of the flight line |
| (B) | There is no relief displacement along the direction of the flight line |
| (C) | The greater is the distance of the ground object from nadir, the lesser is the image scale compression |
| (D) | Linear features have sigmoidal distortion |

| | |
|---|---|
| Q.81 | In case of normalized difference vegetation index (NDVI), which of the following statements is/are correct? |
| (A) | It is functionally equivalent to a simple ratio of red to near infra-red reflectance |
| (B) | It reduces many forms of multiplicative noise |
| (C) | It reduces additive noise |
| (D) | It is sensitive to canopy background variations |
| | |
| | |
| Q.82 | The hue, intensity and saturation values for a pixel are $H = 0.5$ rad, $S = 0.5$ and $I = 0.3$, respectively. If the pixel is converted to RGB color model, then the value of the green pixel would be _____ (rounded off to 2 decimal places). |
| | |
| | |
| Q.83 | The brightness values of four pixels in the input image are shown in the table below. The image is rectified using nearest neighbor intensity interpolation, and the pixel at location (5, 4) in the output image is to be filled with the value from coordinate (5.3, 3.7) in the input image. The brightness value of the pixel at location (5, 4) in the rectified output image is _____ (Answer in integer). |
| | <table><tr><th>Location of pixels in input image (Row, Column)</th><th>Brightness Value</th></tr><tr><td>(5, 3)</td><td>9</td></tr><tr><td>(5, 4)</td><td>11</td></tr><tr><td>(6, 3)</td><td>14</td></tr><tr><td>(6, 4)</td><td>12</td></tr></table> |

Q.84 The error matrix resulting from randomly selected test pixels for a classified image is given below. The Producer's accuracy of class 1 is _____% (rounded off to 1 decimal place).

| | | Reference Data | | | |
|---|---|---|---|---|---|
| | | Class 1 | Class 2 | Class 3 | Class 4 |
| Classified Data | Class 1 | 320 | 8 | 7 | 3 |
| | Class 2 | 12 | 270 | 6 | 2 |
| | Class 3 | 9 | 6 | 410 | 5 |
| | Class 4 | 14 | 2 | 3 | 350 |

# Answer Key for Geomatics Engineering (GE)

| Q. No. | Session | Q. Type | Section | Key/Range | Marks |
|---|---|---|---|---|---|
| 1 | 6 | MCQ | GA | A | 1 |
| 2 | 6 | MCQ | GA | D | 1 |
| 3 | 6 | MCQ | GA | B | 1 |
| 4 | 6 | MCQ | GA | B | 1 |
| 5 | 6 | MCQ | GA | A | 1 |
| 6 | 6 | MCQ | GA | B | 2 |
| 7 | 6 | MCQ | GA | D | 2 |
| 8 | 6 | MCQ | GA | MTA* | 2 |
| 9 | 6 | MCQ | GA | C | 2 |
| 10 | 6 | MCQ | GA | B | 2 |
| 11 | 6 | MCQ | GE-A | A | 1 |
| 12 | 6 | MCQ | GE-A | C | 1 |
| 13 | 6 | MCQ | GE-A | D | 1 |
| 14 | 6 | MCQ | GE-A | D | 1 |
| 15 | 6 | MCQ | GE-A | C | 1 |
| 16 | 6 | MCQ | GE-A | A | 1 |
| 17 | 6 | MCQ | GE-A | B | 1 |
| 18 | 6 | MCQ | GE-A | B | 1 |
| 19 | 6 | MCQ | GE-A | C | 1 |
| 20 | 6 | MCQ | GE-A | B | 1 |
| 21 | 6 | MCQ | GE-A | B | 1 |
| 22 | 6 | MCQ | GE-A | C | 1 |
| 23 | 6 | MSQ | GE-A | A;B;D | 1 |
| 24 | 6 | MSQ | GE-A | B;C;D | 1 |
| 25 | 6 | NAT | GE-A | 1.67 to 1.69 | 1 |
| 26 | 6 | NAT | GE-A | 3 to 3 | 1 |
| 27 | 6 | NAT | GE-A | 0.01 to 0.01 | 1 |
| 28 | 6 | MCQ | GE-A | B | 2 |
| 29 | 6 | MCQ | GE-A | A | 2 |
| 30 | 6 | MCQ | GE-A | D | 2 |

| | | | | | |
|---|---|---|---|---|---|
| 31 | 6 | MCQ | GE-A | A | 2 |
| 32 | 6 | MCQ | GE-A | A | 2 |
| 33 | 6 | MCQ | GE-A | A | 2 |
| 34 | 6 | MCQ | GE-A | A | 2 |
| 35 | 6 | MCQ | GE-A | A | 2 |
| 36 | 6 | MCQ | GE-A | C | 2 |
| 37 | 6 | MSQ | GE-A | C;D | 2 |
| 38 | 6 | MSQ | GE-A | A;B;C | 2 |
| 39 | 6 | NAT | GE-A | 27.15 to 27.30 | 2 |
| 40 | 6 | NAT | GE-A | 0.09 to 0.11 | 2 |
| 41 | 6 | NAT | GE-A | 0.95 to 0.98 | 2 |
| 42 | 6 | NAT | GE-A | 7.25 to 7.45 | 2 |
| 43 | 6 | NAT | GE-A | 408 to 410 | 2 |
| 44 | 6 | NAT | GE-A | 1.14 to 1.34 | 2 |
| 45 | 6 | NAT | GE-A | 0.25 to 0.27 | 2 |
| 46 | 6 | NAT | GE-A | 600 to 600 | 2 |
| 47 | 6 | MCQ | GE-B-SI | C | 1 |
| 48 | 6 | MCQ | GE-B-SI | D | 1 |
| 49 | 6 | MCQ | GE-B-SI | B | 1 |
| 50 | 6 | MCQ | GE-B-SI | C | 1 |
| 51 | 6 | MCQ | GE-B-SI | C | 1 |
| 52 | 6 | MCQ | GE-B-SI | B | 1 |
| 53 | 6 | MCQ | GE-B-SI | A | 1 |
| 54 | 6 | MCQ | GE-B-SI | A | 1 |
| 55 | 6 | MCQ | GE-B-SI | C | 2 |
| 56 | 6 | MCQ | GE-B-SI | C | 2 |
| 57 | 6 | MCQ | GE-B-SI | C | 2 |
| 58 | 6 | MCQ | GE-B-SI | A | 2 |
| 59 | 6 | MSQ | GE-B-SI | A | 2 |
| 60 | 6 | MSQ | GE-B-SI | A;B | 2 |
| 61 | 6 | NAT | GE-B-SI | 59.78 to 59.88 | 2 |
| 62 | 6 | NAT | GE-B-SI | 749.79 to 750.20 | 2 |
| 63 | 6 | NAT | GE-B-SI | 136.770 to 136.790 | 2 |
| 64 | 6 | NAT | GE-B-SI | 1.540 to 1.550 | 2 |
| 65 | 6 | NAT | GE-B-SI | 4 to 4 | 2 |
| 66 | 6 | MCQ | GE-B-SII | B | 1 |
| 67 | 6 | MCQ | GE-B-SII | D | 1 |
| 68 | 6 | MCQ | GE-B-SII | C | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 69 | 6 | MSQ | GE-B-SII | B;D | 1 |
| 70 | 6 | NAT | GE-B-SII | 3.71 to 3.75 | 1 |
| 71 | 6 | NAT | GE-B-SII | 220 to 220 | 1 |
| 72 | 6 | NAT | GE-B-SII | 1.95 to 1.97 | 1 |
| 73 | 6 | NAT | GE-B-SII | 10 to 10 | 1 |
| 74 | 6 | MCQ | GE-B-SII | C | 2 |
| 75 | 6 | MCQ | GE-B-SII | B | 2 |
| 76 | 6 | MCQ | GE-B-SII | A | 2 |
| 77 | 6 | MCQ | GE-B-SII | C | 2 |
| 78 | 6 | MSQ | GE-B-SII | A;B | 2 |
| 79 | 6 | MSQ | GE-B-SII | A;D | 2 |
| 80 | 6 | MSQ | GE-B-SII | B;D | 2 |
| 81 | 6 | MSQ | GE-B-SII | A;B;D | 2 |
| 82 | 6 | NAT | GE-B-SII | 0.28 to 0.32 | 2 |
| 83 | 6 | NAT | GE-B-SII | 11 to 11 | 2 |
| 84 | 6 | NAT | GE-B-SII | 90.0 to 91.0 | 2 |

***MTA= Marks To All**