ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION 2023
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALISATION PAPER FOR GEOGRAPHIC INFORMATION SYSTEM

Date : October 9, 2022
Total Marks : 100
Writing Time : 150 minutes (2.5 hours)
Reading Time : 15 minutes (prior to writing time)

GENERAL INSTRUCTIONS:

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A & SECTION B:
   - **SECTION A** has two parts: Part I - 30 Multiple Choice Questions
     Part II - 4 Short Answer Questions
     All questions under SECTION A are **COMPULSORY.**
   - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions of your choice.
4. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
5. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating the Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part on a fresh page of the Answer Booklet.
7. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
8. Use of any other paper including paper for rough work is not permitted.
9. **You must hand over the Answer Booklet to the Invigilator before leaving the examination hall.**
10. This paper has **7 printed pages**, including this instruction page.

GOOD LUCK

SECTION A

PART I: Multiple Choice Questions [30 marks]

Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g., 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. Which option is another name for a line of latitude?
   a) Meridian
   b) Lesser circle
   c) Parallel
   d) Longitude

2. Which decimal degrees coordinate corresponds to 50°22'10" N?
   a) 50.3667
   b) 50.3639
   c) 50.0028
   d) 50.3694

3. Key requirements of integration of GIS Datasets produced by different agencies is that
   a) The datasets must have compatible accuracy standard
   b) The datasets must have compatible coordinate system
   c) The datasets must have compatible symbolization standards
   d) All of the above

4. Azimuthal projections preserve which of the following spatial properties from one central point to every other point?
   a) Distance
   b) Area
   c) Shape
   d) Direction

5. The map projection used in Drukref03 grid is
   a) Polyconic
   b) Transverse Mercator
   c) Lamberts conformal conic
   d) Conic

6. What is the primary purpose of triangulation in surveying?
   a) Measuring distances accurately
   b) Establishing property boundaries
   c) Determining elevation changes
   d) Determining the location of distant points

7. Which of the following is correct regarding Triangulated Irregular Network (TIN)?
   a) It is set of adjacent, non-overlapping triangles computed from irregularly spaced points.
   b) It is vector-based representation of physical land surface, made with irregularly distributed nodes and lines.
   c) It is most suitable method for representing a continuous surface in a vector GIS system.
   d) All of the above.

8. Which among the following wave is not employed in case of remote sensing?
   a) X-ray
   b) Visible ray
   c) Thermal IR
   d) Radio waves

9. In photogrammetry, what is an "orthophoto"?
   a) A photo with an orthographic projection
   b) An aerial photo taken with a drone
   c) A photo taken from a satellite
   d) A photo corrected for geometric distortions to create a map-like image

10. An 8-bits image can have _____ total number of pixel values.
    a) 64
    b) 128
    c) 256
    d) 65536

11. Which attribute or feature type can be represented as continuous data?
    a) Hydrography
    b) Land use
    c) Soil type
    d) Elevation

12. Which band combination helps users identify healthy vegetation?
    a) Red, Green, Blue
    b) Near infrared, Red, Green
    c) Panchromatic
    d) Red, Green, Coastal

13. How can modifying band combinations assist with interpreting different phenomena and features within an image?
    a) Because modifying band combinations provides a work-around to visualize multiple single-band images at one time, phenomena and features can be easily interpreted.
    b) Because modifying band combinations creates a copy of the image, the features and phenomena in the images can be compared side by side in the software.
    c) Because spatial resolution determines which phenomena and features are visible, certain band combinations can be used to provide further clarity of the image.
    d) Because different features absorb and reflect energy differently, specific band combinations can highlight or exaggerate phenomena and features within an image

14. Which statement best describes the shape of the earth?
    a) The earth is a prolate ellipsoid, which closely approximates a sphere.
    b) The earth is an oblate ellipsoid, which closely approximates a sphere.
    c) The earth's shape bulges at the two poles.
    d) The earth is a perfect sphere.

15. In which of the following ways, meridians are projected in cylindrical projection.
    a) Mathematically
    b) Geometrically
    c) Horizontally
    d) Vertically

16. _____ are devices on which camera or sensors are mounted for viewing earth to get image or photographs.
    a) Platforms
    b) Mounting
    c) Radio antenna
    d) None of the above

17. A vertical photograph was taken from an aircraft flying at an altitude of 2000 m above mean sea level. The focal length of the camera is 175 mm. The scale of the photograph for a hill of an elevation of 250 m is
    a) 1/10000
    b) 1/150000
    c) 1/200000
    d) 1/25000

18. To determine the shortest route between two hospitals. Which collection of geoprocessing tools would be a good place to start when looking for a routing tool?
    a) Network Analyst Tools
    b) Analysis Tools: Overlay toolset
    c) Analysis Tools: Statistics toolset
    d) Analysis Tools: Proximity toolset

19. Determine the scale of the map if the distance on the map is given as 2cm which is equal to 1km on the ground.
    a) 1: 50000
    b) 1: 5000
    c) 1: 100000
    d) 1: 500000

20. Type of surveying in which the shape of the earth taken into account is _____
    a) Topographic Surveying
    b) Hydrographic Surveying
    c) Geodetic Surveying
    d) Plane Surveying

21. Which image classification technique allows the algorithm to define classes during image classification?
    a) Deep learning object-based
    b) Unsupervised pixel-based
    c) Supervised object-based
    d) Supervised pixel-based

22. Resampling of a raster image:
    a) Increases the accuracy
    b) Increases the precision
    c) Decreases data details
    d) Increases data details

23. _____ often referred to as bit depth, is the range of possible data values that can be stored in each band. It describes sensitivity or brightness values to distinguish features viewed in the same region of the EMS.
    a) Spectral resolution:
    b) Spatial resolution:
    c) Radiometric resolution:
    d) Temporal resolution:

24. The electromagnetic spectrum (EMS) helps users understand which information?
    a) Particular wavelength ranges where remote sensing sensors collect, measure, and record responses from various regions of energy
    b) Highly accurate measurement recordings from pulsed light energy returning from the surface of the earth to the active sensor
    c) The spatial resolution or the area of the ground represented in each individual pixel in the imagery dataset
    d) Using precise wavelength measurements to determine the geographic coordinate system in which the imagery dataset should be visualized

25. _____represent meridians as straight, evenly spaced, vertical lines; they represent parallels as straight, horizontal lines.
    a) Cylindrical projections
    b) Conic projections
    c) Planar projections
    d) None of the above

26. The best approach for storing a large quantity of GIS dataset that need to be constantly revised, accessed, manipulated and updated by multiple users would be
    a) Shape files
    b) Personal Geodatabase
    c) Raster files
    d) Enterprise Geodatabase

27. The process of using known values of a point to estimate the value of unknown points in the same or nearby region is called
    a) Spatial Interpolation
    b) Spatial Prediction
    c) Spatial Adjustment
    d) Spatial Estimation

28. The geometric transformation of a remote sensing image to a map projection plane is best described by
    a) resampling
    b) image rectification
    c) georeferencing
    d) image calibration

29. It is easy to integrate GIS, Remote Sensing and GPS technologies because these are
    a) Digital, special and generic
    b) Digital, analogue and manual
    c) Digital, spatial and generic
    d) Negative, positive and neutral

30. A satellite image with 1m spatial resolution covers an area of $1m^2$, whereas a pixel with 0.1m spatial resolution covers an area of
    a) 0.1 m^2
    b) 0.001 m^2
    c) 10 cm^2
    d) 100 cm^2

PART II – Short Answer Questions [20 marks]

This part has 4 Short Answer Questions. Answer ALL the questions. Each question carries 5 marks.

1. What is geoprocessing in GIS, and how does it enhance spatial analysis capabilities? Provide examples of geoprocessing tools and their applications.

2. Explain the following terms
    a) Active remote sensing
    b) Spheroid
    c) Spectral resolution
    d) Ground sampling distance
    e) Pan sharpening

3. Describe the concept of remote sensing image classification. What are supervised and unsupervised classification methods, and how are they applied in remote sensing analysis?

4. What are geodatabases in GIS, and how do they differ from file-based data storage? Explain the advantages of using geodatabases in GIS workflows.

SECTION B: Case Study [50 marks]

Choose either CASE I OR CASE II from this section. Each case study carries 50 marks.

CASE I

The ongoing crisis in Ukraine, exacerbated by the covid 19 pandemic, has drawn global scrutiny towards the worldwide food crisis and its impact on individual nations' food security. In light of this, the Ministry of Agriculture and Livestock is presently drafting the 2022 Draft Food and Nutrition Security Policy for Bhutan.

Assuming the role of a GIS officer within the aforementioned agency, explain step-by-step on how would you apply Geographic Information System (GIS) and Remote Sensing (RS) technology can be optimally used as a policy intervention tool to enhance food production efficiency, leading to increased food self-sufficiency and security.

CASE II

One of the most prominent characteristics of Bhutan's environment lies in its unwavering commitment to the preservation of its rich biodiversity. The nation has steadfastly pursued a delicate equilibrium between advancing human development and safeguarding its natural surroundings. Bhutan has recognized the conservation of the environment as one of the pillars of Gross National Happiness—a testament to its environmental dedication. As part of this endeavour, the National Land Commission has recently published the Land Use Land Cover (LULC) maps for the year 2020.

As a GIS officer, you've been assigned the responsibility of creating the next edition of Land Use and Land Cover (LULC) maps for Bhutan. Briefly outline the general methodology you would adopt to develop the next edition of LULC maps for Bhutan.

TASHI DELEK!