

**ROYAL CIVIL SERVICE COMMISSION  
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2024  
EXAMINATION CATEGORY: TECHNICAL**

**PAPER III: SUBJECT SPECIALISATION PAPER FOR GEOGRAPHIC INFORMATION SYSTEM**

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**Date** : October 9, 2024  
**Total Marks** : 100  
**Writing Time** : 150 minutes (2.5 hours)  
**Reading Time** : 15 minutes (prior to writing time)

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**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 spatial analysis technique is used to determine the visibility between two points?
  - a) Buffer Analysis
  - b) Viewshed Analysis
  - c) Network Analysis
  - d) Overlay Analysis
2. What does the "Fuzzy Logic" approach in GIS deal with?
  - a) Precise binary classification
  - b) Handling Uncertainty in Spatial Data
  - c) 3D Terrain Modelling
  - d) Network routing optimization
3. Which of the following is a key advantage of using remote sensing technology?
  - a) Inadequate temporal coverage
  - a) Ability to gather data from inaccessible areas
  - b) High cost of implementation
  - c) Dependency on weather conditions
4. The integration of Artificial Intelligence (AI) in GIS is most beneficial for
  - a) Automating map coloring
  - b) Predictive spatial modeling and pattern recognition
  - c) Reducing satellite image costs
  - d) Printing paper maps faster
5. The fundamental requirement for 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
6. In remote sensing, the term 'spectral resolution' refer to
  - a) The width of the electromagnetic spectrum that a sensor can capture
  - b) The size of the smallest feature that a sensor can detect
  - c) The number of bands in the electromagnetic spectrum captured by a sensor
  - d) The ability of a sensor to distinguish between different wavelengths

7. Which of the following is a primary application of LIDAR technology?
  - a) Measuring sea surface temperatures
  - b) Monitoring atmospheric gases
  - c) Mapping topography
  - d) Analyzing land cover changes
8. The term "Digital Twin" in geospatial science refers to
  - a) A 3D printed map
  - b) A virtual replica of a physical environment updated in real-time
  - c) A high-resolution satellite image
  - d) A drone-captured topographic model
9. The map projection used in DRUKREF03 grid is
  - a) Polyconic
  - b) Transverse Mercator
  - c) Lamberts conformal conic
  - d) Conic
10. Which satellite constellation provides high-temporal-resolution imagery for disaster monitoring?
  - a) Landsat
  - b) Planet Scope
  - c) MODIS
  - d) Sentinel-1
11. 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
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. 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
14. Resampling of a raster image
  - (a) Increases the accuracy
  - (b) Increases the precision
  - (c) Decreases data details
  - (d) Increases data details

15. 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
16. Which algorithm is commonly used for shortest path analysis in network datasets?
  - a) Kriging
  - b) Dijkstra's Algorithm
  - c) Moran's I
  - d) IDW (Inverse Distance Weighting)
17. What is the process of assigning coordinates to the pixel values of an image known as?
  - a) Digitization
  - b) Georeferencing
  - c) Projection
  - d) Resampling
18. Which open-source GIS software is widely used for machine learning-based spatial analysis?
  - a) QGIS with Python plugins
  - b) ArcGIS Online
  - c) Google Earth Pro
  - d) AutoCAD Map
19. Which of the following best describes the concept of 'geocoding'?
  - a) Collecting geographic coordinates
  - b) Converting addresses into geographic coordinates
  - c) Projecting geographic data
  - d) Creating digital maps
20. In disaster management, which GIS operation is typically used for evaluating flood risk areas?
  - a) Network analysis
  - b) Overlay analysis
  - c) Buffer analysis
  - d) Geostatistical analysis
21. Which of the following techniques is commonly used for change detection in remote sensing?
  - a) Image classification
  - b) Principal Component Analysis (PCA)
  - c) Image differencing
  - d) Spectral unmixing

22. Which of the following characteristic of a satellite imagery is most relevant for studying change detection over a period of time
- a) Spatial resolution
  - b) Spectral resolution
  - c) Temporal resolution
  - d) All of the above
23. What is the role of 'metadata' in geospatial data management?
- a) To store the spatial coordinates
  - b) To describe the content, quality, condition, and other characteristics of data
  - c) To visualize the spatial data
  - d) To perform spatial analysis
24. Which of the following is true?
- a) While the contour map has height information, the DEM provides elevation information
  - b) Contour map represents height information discretely, while DEM provides it continuously
  - c) Contour is a raster dataset and DEM is a vector dataset
  - d) A contour map is more precise than a DEM
25. The term "GeoAI" refers to:
- a) Geographic Artificial Intelligence for spatial problem-solving
  - b) A new GPS satellite
  - c) A type of geodatabase
  - d) A drone mapping technique
26. What is the role of blockchain in geospatial data management?
- a) Ensuring data immutability and transparency
  - b) Reducing image resolution
  - c) Creating 3D maps
  - d) Replacing GPS systems
27. Which emerging technology combines GIS with real-time sensor data for dynamic spatial analysis?
- a) IoT-enabled GIS
  - b) Blockchain GIS
  - c) Quantum GIS
  - d) Augmented Reality GIS
28. The term "Spatial Data Infrastructure" (SDI) refers to:
- a) A framework for sharing geospatial data across organizations
  - b) A type of drone
  - c) A new map projection
  - d) A LiDAR sensor

29. What is the purpose of "geofencing" in location-based services?
- a) To create virtual boundaries for triggering alerts
  - b) To improve satellite resolution
  - c) To reduce GPS battery usage
  - d) To encrypt geospatial data
30. What is the primary purpose of a "Topology Rule" in GIS?
- a) To enhance map aesthetics
  - b) To enforce spatial relationships between features
  - c) To improve GPS accuracy
  - d) To compress raster data

**PART II – Short Answer Questions [20 marks]**

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

1. Explain the following terms used in spatial analysis
  - a) Kriging
  - b) Moran's I
  - c) IDW (Inverse Distance Weighting)
  - d) Pixel
  - e) Resolution
2. How do topology rules improve the GIS data quality? Explain with few examples.
3. A researcher claims NDVI values from two different satellite images (example: Sentinel-2 and Landsat 8) are not directly comparable. Justify the claim.
4. Discuss some of the major challenges and issues of Land Use and Land Cover Classification using remotely sensed satellite images. Describe and propose solutions to address such issues to generate a reliable Land use and Land Cover Map of Bhutan.

**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 National Land Commission (NLC), in collaboration with the Cabinet Secretariat, is implementing a National Framework for Integrated Land Use and Spatial Planning to harmonize sectoral spatial plans to support Bhutan's 10X Economic Roadmap.

As a newly appointed **GIS Officer**, your role is critical in ensuring cross-sectoral alignment. Discuss:

1. **Technical Approach:** How would you use GIS and remote sensing to integrate disparate land-use datasets (e.g., forestry, urban, transport) into a unified spatial plan?
2. **Stakeholder Coordination:** What strategies would you employ to resolve conflicts between sectoral plans (e.g., mining vs. conservation areas)?
3. **Innovative Solutions:** Propose one digital tool or methodology (e.g., WebGIS, participatory mapping) to improve inter-agency collaboration.

**Case II**

To enhance the health care services in the country, the Ministry of Health (MoH) wants to establish a new hospitals or health care centers in the 20 Dzongkhags of Bhutan. However, the Ministry has no idea where should the hospitals be suitably located.

As a GIS professional, describe how you would use the application of GIS to do a Land Suitability Analysis to determine the best site for a new healthcare centre. Describe and explain necessary steps and the methodology or framework that you would like to adopt to produce the desired output and guide informed-decision making.

**TASHI DELEK!**