

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

### PAPER III: SUBJECT SPECIALISATION PAPER FOR ICT

**Date** : October 5, 2024  
**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 - 6 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 **10 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. In computing, one terabyte(TB) is equal to:
  - a) 1024 GB
  - b) 1000 GB
  - c) 1024 MB
  - d) 1000 MB
2. Which of the following protocols is used for email transmission?
  - a) SNMP
  - b) HTTP
  - c) FTP
  - d) SMTP
3. What does the hexadecimal color code #FFFFFF represent?
  - a) Black
  - b) Black and White
  - c) White
  - d) RBG
4. Which of the following languages is commonly used for front-end web development?
  - a) SQL
  - b) PHP
  - c) JavaScript
  - d) Python
5. What characteristic is NOT typically associated with Big Data?
  - a) Velocity
  - b) Volume
  - c) Veracity
  - d) Variability
6. What is the primary goal of sentiment analysis?
  - a) To measure the sentiment or emotion expressed in textual data
  - b) To clean and prepare data
  - c) To store data
  - d) To predict future trends

7. Convert the subnet mask 255.255.255.240 into CIDR notation.
  - a) /30
  - b) /29
  - c) /28
  - d) /27
  
8. In Scrum, what is a "sprint"?
  - a) A set of user stories.
  - b) A fixed-duration iteration for completing a set of work.
  - c) A meeting to review project progress with management.
  - d) A user specification document.
  
9. What is Infrastructure as Code (IaC) in DevOps?
  - a) The process of integrating code into a central repository.
  - b) The process of documenting infrastructure manually.
  - c) Managing and provisioning infrastructure through code and automation tools
  - d) Writing code for software applications.
  
10. Which algorithm is commonly used for public key cryptography?
  - a) SHA-256
  - b) RSA
  - c) AES
  - d) DES
  
11. Which version control system is widely used in DevOps practices?
  - a) Git
  - b) Apache
  - c) Asana
  - d) Oracle
  
12. How is data typically managed in a microservices architecture?
  - a) All data is stored in files.
  - b) A single database shared by all services.
  - c) No databases are used.
  - d) Each microservice has its own independent database.
  
13. What is the main purpose of a subnet mask in networking?
  - a) To encrypt data being transmitted.
  - b) To assign IP addresses to devices.
  - c) To divide an IP address into network and host portions.
  - d) To identify the MAC address of a device.

14. Which type of network architecture typically uses a central server to manage network resources?
- a) Mesh network.
  - b) Peer-to-peer network.
  - c) Client-server network.
  - d) Bus network.
15. What is the logical way to handle network congestion in a design?
- a) Implement Quality of Service (QoS) to prioritize critical traffic.
  - b) Reduce the number of users on the network.
  - c) Only use wired connections.
  - d) Use Cat6 cables.
16. What is an "agile methodology" in the context of digital transformation?
- a) A static approach to project management.
  - b) A method for business process reengineering.
  - c) A flexible and iterative approach to project management.
  - d) A method to include both software and hardware aspects.
17. Which protocol is commonly used for remote management of data center devices?
- a) VPN
  - b) HTTP
  - c) HTTPS
  - d) SNMP
18. What does the term "edge computing" refer to in the context of IoT?
- a) Performing computation in the cloud.
  - b) Performing computation in mainframe computers.
  - c) Performing computation on local devices close to the source of data.
  - d) Performing computation at data centers.
19. Which feature of blockchain ensures that once data is recorded, it cannot be altered?
- a) Decentralization
  - b) Immutability
  - c) Ledgers
  - d) Scalability
20. Which of the following is a type of Machine Learning where the algorithm is trained on labeled data?
- a) Reinforcement Learning
  - b) Unsupervised Learning
  - c) Supervised Learning
  - d) Both B and C

21. Which of the following is a method of securing data in transit?
- a) Encryption
  - b) Decryption
  - c) Firewall
  - d) Cloud storage
22. Which security measure is commonly used by payment gateways to protect sensitive data?
- a) HTTPS
  - b) Plain text data storage
  - c) Open access to transaction logs
  - d) SSL (Secure Socket Layer) encryption
23. Which of the following formats is most commonly used to structure data in a RESTful API response?
- a) CSV
  - b) HTML
  - c) JSON
  - d) XML
24. What type of diagram can be used to complement a DFD by showing the structure of data within the system?
- a) Sequence Diagram
  - b) Gantt Chart
  - c) Flowchart
  - d) Entity-Relationship Diagram (ERD)
25. What will be the output of the following code snippet?
- ```
fruits = ["apple", "banana", "cherry"]  
print(len(fruits))
```
- a) 5
  - b) 4
  - c) 3
  - d) 2
26. Which `chmod` command will give read and write permissions to the owner, and read-only permissions to the group and others?
- a) `chmod 755`
  - b) `chmod 644`
  - c) `chmod 777`
  - d) `chmod 622`

27. Which of the following statements is correct?
- a) A relation in 2NF is always in 3NF
  - b) A relation in 1NF is always in 2NF
  - c) A relation in BCNF is always in 3NF
  - d) A relation in 3NF is always in BCNF
28. Which command is used to check connectivity or if a port is open on a network?
- a) ping
  - b) traceroute
  - c) netstat
  - d) telnet
29. The SQL *WHERE* clause:
- a) Limits the column data that are returned.
  - b) Limits the row data that are returned.
  - c) Both A and B are correct.
  - d) Neither A nor B are correct.
30. Which of the following cloud computing service models provides the most comprehensive solution for end-users, including fully functional applications?
- a) SaaS
  - b) IaaS
  - c) FaaS
  - d) PaaS

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

**This part has 6 Short Answer Questions. Answer ALL the questions. Marks for each question are indicated in the brackets.**

1. What is the principle of least privilege in network security and why is it needed? **(2 marks)**
2. What is cloud computing and state briefly any two types of cloud service models? **(3 marks)**
3. Briefly state what is descriptive analytics, predictive analytics, and prescriptive analytics **(3 marks)**
4. For the following code, write the output ( **3 marks**)

```
public class Main {  
    public static void main(String[] args) {  
        int[][] matrix = {  
            {1, 2, 3},  
            {4, 5, 6},  
            {7, 8, 9}  
        };  
        int sum = 0;  
        for (int i = 0; i < matrix.length; i++) {  
            sum += matrix[i][i];  
        }  
        System.out.println("Output is : " + sum);  
    }  
}
```

5. How many hosts can be addressed in a Class C network and what is the subnet mask for a network with 4 subnets each capable of hosting up to 30 devices? **(4 marks)**
6. Explain the importance of multi-factor authentication (MFA) in enhancing cybersecurity. How does it improve security compared to traditional password-only authentication? **(3+2 marks)**

**SECTION B: Case Study [50 marks]**

**Choose either CASE I OR CASE II from this section. Each case study carries 50 marks. Mark for each sub-question is indicated in the brackets.**

**CASE I**

You have been hired as a network consultant to design a comprehensive, secure, and efficient network for the new office of Kuensel Corporation. This office will accommodate 200 employees across various departments, including Marketing, HR, Finance, IT, and Sales, distributed over three floors. Each department requires dedicated resources and services, including file sharing, permissions management, high-speed internet access, and secure internal communication. The network must support high-bandwidth applications such as video conferencing and data transfers while ensuring data security and integrity. Additionally, the office requires centralized storage solutions for file sharing and backup, along with effective user access controls. The design should also consider scalability for future growth and secure connectivity to a branch office located in a different city.

1. Propose a suitable network topology for ABC Corporation's new office, considering that the office spans three floors. Your design should consider departmental segregation, scalability, and fault tolerance. Justify your choice and illustrate it with both a physical and logical network diagram. **(8 Marks)**
2. Design an IP addressing scheme for the office network. Allocate subnets for each department and floor, considering future growth. Specify the subnet masks, IP ranges, and explain your rationale. **(8 Marks)**
3. Identify and describe at least four essential network devices required for setting up the new office network. Explain the role of each device in the network infrastructure. **(8 Marks)**
4. Outline any three security technologies for the new office network and explain why. Also, describe how you would securely connect the branch office in a different location. **(8 Marks)**
5. Identify any three technologies you would implement to ensure the network can handle high-bandwidth applications and maintain optimal performance for all users. **(6 Marks)**
6. Explain how you would set up file sharing within the network and manage user permissions effectively. What tools or protocols would you use? **(6 Marks)**
7. Recommend storage solutions for the office network, considering factors such as backup, scalability, and data redundancy. Justify your recommendations. **(6 Marks)**

## **CASE II**

The Department of Forests and Park Services (DoFPS) is one of the largest government departments in Bhutan, responsible for managing, conserving, and sustainably using forest resources and protected areas. Their primary functions encompass sustainable forest management, wildlife protection, community forestry promotion, protected area management, afforestation and reforestation efforts, forest research, enforcement of forestry and wildlife regulations, and environmental education and awareness.

Because of their extensive mandate, they have a large number of employees stationed across the country and therefore, want to implement an Employee Management System (EMS) to effectively manage its growing workforce. The EMS should capture the following information:

- For each employee, the database should record the Employee ID, Name, Contact Number, Email, Employee Type (Regular/Contract), Address (Village, Gewog, Dzongkhag), Job Title, Department and Role, Status( Active/Resigned)
- For each leave, the database should record Leave Type, Total Number of Days Eligible, Availed Leave, and Leave Balances.
- For each training, the database should record the Training Type (STT, LTT, Workshop, Conference), Name, Start date, End date, Organizer, Place
- For each patrolling, the database should record Date, Location, Purpose, Duration, and Remarks

### **Question 1: Entity-Relationship Model (12 marks)**

- Identify the entities and their attributes for the DoFPS Employee Management System database. **(3 marks)**
- What is the difference between a primary key and a foreign key? **(2 marks)**
- Develop an ER model showcasing the relationships between these entities. State any assumptions you make and indicate all the relationships and constraints in your model. **(7 marks)**

### **Question 2: Normalization (8 marks)**

- What is Normalization? Why does it need to be carried out? **(2 marks)**
- Explain the process of normalizing the database schema you created in Question 1. Ensure that your final design is in at least 3rd Normal Form (3NF). Provide examples and explain each step. **(6 marks)**

### **Question 3: SQL Queries (10 marks)**

- Write SQL queries to:
  - *Add a new employee. (2 marks)*
  - *Assign a training to the above employee (2 marks)*
  - *Update the contact number and email of an employee. (2 marks)*
  - *Retrieve a list of all workshops attended by the employees. (2 marks)*
  - *Retrieve records of employees who have left the organization. (2 marks)*

**Question 4: ACID Transaction (4 marks)**

- i. What does ACID stand for in database transactions? Explain each briefly. **(4 marks)**

**Question 5: Software Development Life Cycle (10 marks)**

- i. What is a Software Development Life Cycle (SDLC)? Give some examples. **(2 marks)**
- ii. Explain briefly major phases of SDLC. **(4 marks)**
- iii. Differentiate between functional and non-functional requirements. Specify two function and non-functional requirements from the above case study. **(4 marks)**

**Question 6: Authentication and Security (6 marks)**

- i. What does SSO stand for? Explain its concept and give an example where you have used it. **(3 marks)**
- ii. Discuss three measures to ensure the security of the DoFPS EMS database. **(3 marks)**

**TASHI DELEK**