ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2016
EXAMINATION CATEGORY: <u>TECHNICAL</u>

PAPER III: SUBJECT SPECIALISATION PAPER FOR ICT

Date:	2 October 2016
Total Marks:	100
Examination Time:	150 minutes (2.5 hours)
Reading Time:	15 minutes *(prior to examination time)*

GENERAL INSTRUCTIONS

1. Write your Registration Number clearly and correctly on the Answer Booklet.

2. The first 15 minutes is being provided to check the number of pages, printing error, clarify doubts and to read instructions in Question Paper. You are NOT permitted to write during this time.

3. This paper consists of **TWO Sections, namely Section A and 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 2 case studies. Choose only **ONE** case study and answer the questions under 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 correct Section, Part and Question Number will NOT be evaluated and no marks would be awarded.

6. Begin each Section and Part in 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 are required to hand over the Answer Booklet to the Invigilator before leaving the examination hall.

10. The Question paper has 10 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 (c). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. What is the addition of binary numbers $(11111) + (11010)$?

   a. 101100
   b. 111011
   c. 110001
   d. 111001

2. Which of the following device is not used as LAN extension devices?

   a. Network interface card
   b. Gateway
   c. Switch
   d. Bridge

3. Given the expression $a * b + c * d$, what would be its postfix notation?

   a. $ab * +cd*$
   b. $a * bc + d*$
   c. $ab * cd * +$
   d. $ab + cd **$

4. What would be the output of the following C code?

```c
#include<stdio.h>
int main()
{
    char x = 65;
    char y = 0;
    y = x + 5;
    printf("%c, %d\n", x, y);
    return 0;
}
```

   a. A, F
   b. a, f
   c. A, 70
   d. a, 70

5. During requirement gathering for a system development, client says that system must support 50 concurrent users. This requirement is

    a. Functional requirement
    b. Quality requirement
    c. Platform requirement
    d. Process requirement

6. Which scheduling policy is most suitable for a time-shared operating system?

    a. Shortest-job First Scheduling
    b. First-Come-First-Serve Scheduling
    c. Round-Robin Scheduling
    d. Priority Scheduling

7. A technique of temporarily removing inactive programs from the memory of computer system is called

    a. Swapping
    b. Spooling
    c. Semaphore
    d. Scheduler

8. When a programming language has the capability to produce new data type, it is said to be

    a. Extensible
    b. Overloaded
    c. Encapsulated
    d. Reproducible

9. 'LRU' page replacement policy is

    a. Last Replacement Used
    b. Last Restored Unit
    c. Least Required Unit
    d. Least Recently Used

10. A digital signature is

    a. a hashed value giving identity of correspondents.
    b. a unique identification code of a sender.
    c. a technique used to validate the authenticity and integrity of a message.
    d. an electronic signature of a sender.

11. Which of the following is a next-generation web content development language, which typically refers to a suite of technologies that allow developers to store data in a readable format?

    a. XML
    b. PHP
    c. HTML
    d. XSL

12. Which of the following is TRUE regarding a '*procedure*' in database?

    a. They are not created with SQL.
    b. They do not need to have a unique name.
    c. They include procedural and SQL statements.
    d. They are the same thing as a function.

13. Given the value of *int A = 5*, what is the difference between following two print statements?

printf("%d %d %d\n", A, A- - , - -A);

printf("%d ", A); **printf("%d ", A- -);** **printf("%d\n", - -A);**

    a. Same output format, Same output values
    b. Same output format, Different output values
    c. Different output format, Same output values
    d. Different output format, Different output values

14. The objective of **Use Case Analysis** in system design is to

    a. show number of users.
    b. show perspective of how users interact with the system.
    c. show number of system components.
    d. show overview of dataflow in the system.

15. In OSI model, the network layer _____.

    a. takes care of reliable transmission of data and it contains protocols.
    b. take care of reliable delivery of data across a physical network by packaging, addressing and transmitting.
    c. takes care of electrical/light communication across the network media.
    d. take care of the routing data to a system on the network and handles the addressing and delivery of data.

16. ODBC stands for _____.

    a. Open Database Connection
    b. Offline Database Connection
    c. Online Database Connection
    d. Optional Database Connection

17. A function argument is _____.

    a. A variable in the function that receives a value from the calling program.
    b. A way that functions resist accepting the calling program's values.
    c. A value sent to the function by the calling program.
    d. A value returned by the function to the calling program.

18. What would be the output of the following java code?

```
public class myCode{
    public static void main(Strings []args){
        int a = 10, b =0;
        if(a/b == 0){
            System.out.println("Great");
        }
        else
            System.out.println("Not bad");
    }
}
```

a. Run time error
b. Compile time error
c. Great
d. Not bad

19. Which of the following statement is CORRECT for virtual memory?

a. It allows for multiple users to use the system.
b. It enhances scope for multi programming.
c. It extends the Physical Address.
d. It reduces Internal Fragmentation problem.

20. The Hardware mechanism that enables a device to notify the CPU is called

a. Interrupt
b. Polling
c. System Call
d. All of the above

21. A waiting process is never again able to change state, because other waiting processes hold the resources it has requested. This situation is called

a. Starvation
b. Livelock
c. Deadlock
d. Infinite Blocking

22. The number of processes completed per unit time is known as _____.

a. Output
b. Throughput
c. Efficiency
d. Capacity

23. XOR logic gates can be constructed from using what other logic gates?

    a. OR gates only
    b. OR gates and NOT gates
    c. AND gates and NOT gates
    d. AND gates, OR gates and NOT gates

24. One of De Morgan's theorems states that $\overline{X + Y} = \overline{X} \cdot \overline{Y}$. Simply stated, this means that logically there is no difference between:

    a. a NOR and an AND gate with inverted inputs
    b. a NAND and an AND gate with inverted inputs
    c. an AND and a NOR gate with inverted inputs
    d. a NOR and a NAND gate with inverted inputs

25. The hexadecimal equivalent of the octal number 777 is:

    a. FFF
    b. 1FF
    c. FF1
    d. F1F

26. Consider the join of a relation **R** with relation **S**. If **R** has *m* tuples and **S** has *n* tuples, then the maximum size of join is:

    a. *mn*

    b. *m+n*

    c. *(m+n)/2*

    d. *2(m+n)*

27. Identify the IP address class, if two bits of first octet are fixed at **10**.

    a. Class A
    b. Class B
    c. Class C
    d. Class D

28. Suppose a workstation has a clock rate of 25 MHz, which means that the machine is capable of performing 25 million operations per second. Assuming the average instruction takes 2.5 clock cycles, how many instructions can be executed in 100 microseconds?

    a. 1000000 instructions
    b. 100000 instructions
    c. 1000 instructions
    d. 100 instructions

29. In a Star networking topology:

   a. A common cable connects all the nodes.
   b. Each node is connected to a central hub
   c. Each computer is connected to all other computers.
   d. The node at the highest point usually controls the network

30. What is zero-day vulnerability?

   a. A security hole that is unknown to a vendor or a user.
   b. An error in the software, which is not critical.
   c. A bug in the software that cannot be fixed by a user.
   d. A known security hole that is being exploited by the hackers.

PART-II: Short Answer Questions (20 Marks)

Answer ALL the questions. Each question carries 5 marks. Mark for each sub-question is indicated in the brackets.

1. Testing is one of the fundamental processes in the software development life cycle and there are different types of testing. With respect to testing:

   a) What do you understand by Black-Box Testing and White-Box Testing?   *(2 marks)*
   b) Who conducts these two types of testing?   *(1 mark)*
   c) What is baseline reference (Test Cases) for testers to conduct above two tests?

   (2 marks)

2. In a network address of 10.10.1.0/26, answer the following questions:

   a) What is the broadcast address of the network?   (*1 mark*)
   b) What is the number of usable IP addresses?   (*2 marks*)
   c) What is the subnet mask of this network?   (*2 marks*)

3. In system analysis phase, combinations of many different techniques are used to clearly understand the system requirements. Briefly explain at least 5 techniques used for gathering system requirements.   (*1x5 = 5 marks*)

4. In operating system, processes use different scheduling techniques to do their jobs. For the following given processes, all the processes arrive at the same time:

Process	Burst Time (ms)
P1	6
P2	8
P3	2
P4	4

a) Calculate the **Average Waiting Time** and **Average Turnaround Time** using First-Come First-Serve (FCFS) Scheduling. Assume the order as given in the table.
(2 marks)

b) Calculate the **Average Waiting Time** and **Average Turnaround Time** using Shortest Job First (SJF) Scheduling. *(2 marks)*

c) In performance and throughput, SJF is much better than FCFS scheduling, still in some real situations, why would you use FCFS scheduling? (*1 mark*)

SECTION B

Case Study

Choose either Case 1 or Case 2 from this section. Each Case carries 50 marks. Mark for each sub-question is indicated in the brackets.

CASE 1

The newly established State Owned Enterprise, Rural Enterprise Development Corporation Limited (REDCL) provides financial support to stimulate the growth of cottage and small manufacturing industries in rural Bhutan. It provides micro loans, which will be used to finance start-up or development of the small projects and industries in rural areas. The institution has been receiving hundreds of loan applications and it is overwhelming tasks to manage, process and approve loans manually. To make the loan management easier and effective, the office is looking to use information technology to develop Loan Management System (LMS).

As a start-up, LMS will be small standalone system, which will capture following information:

- The loan applicant's information with their name, CID, phone number and address. The address information will have village, Gewog and Dzongkhag.
- The applicant can apply and avail one or more loans, based on loan types. The loan types can be diary, fishery, poultry, piggery, orchards, vegetables or others.
- The loan will contain information about loan amount, loan type, equated monthly instalment (EMI), payback period, date, brief description of the project for which the money will be used.
- Repayment details, which will record amount and date.
- If the loan is not repaid before the agreed upon deadline, a new date is agreed. The database must not delete the old deadline, but save the history to maintain audit trails.

In relation to LMS system requirement, design and development, answer all the following questions:

a) In the given dataset, some attributes of an entity may be of multi-valued attributes.

   i. Give two examples of probable multi-valued attributes from above data. *(1 mark)*

   ii. What is the problem with multi-valued attribute in database design? *(2 marks)*

   iii.   How can you solve the multi-valued attribute problem? *(2 marks)*

b) To design a database for LMS:

   i.   Create an E-R model for the data described above. State any assumptions you make and indicate all the constraints and relationships in your model. (*10 marks*)

   ii.   Using SQL DDL, create **Loan** and **Applicant** tables. Make reasonable assumptions about data types and necessary data integrity constraints and relationships required between two tables. *(4+6 = 10 marks)*

c) It is mentioned that any changes made in the loan deadline date must maintain audit trails. Explain the importance of maintaining audit trail in any system. (*5 marks*)

d) The initial requirement of LMS is to develop a standalone system, even though organizations use different types of information systems based on their business/operational needs.

   i.   What are the advantages and disadvantages of using standalone system? *(5 marks)*

   ii.   Explain briefly at least 3 other types of information systems used by an organization. *(5 marks)*

e) If you were IT Project Manager of the LMS project, what would be your envisaged key roles and responsibilities? *(5 marks)*

f) The implementation of above solution will partially improve the service delivery and administrative functions of the REDCL. Assuming you are an ICT officer of the institution, what would be your recommendations to the CEO in adopting IT systems? *(5 marks)*

CASE 2

The College of Natural Resources has initiated a project to harness the power of ICT in enhancing the quality of teaching and learning. The main objective is to create effective teaching and learning environment in the college. The first phase of the project is to build a robust ICT infrastructure to provide reliable and faster Internet connectivity. The college is also building a centralized research repository system that will help lecturers and students to access research databases within their network.

a) It is recommended to build a campus network using three-layer hierarchical network design model in the college to provide reliable and secure network. Draw schematic network diagram of three-layer hierarchical network and explain each layer of the network? *(10 marks)*

b) Describe advantages of three-layer hierarchical network design? *(5 marks)*

c) How is OSI model different from three-layer hierarchical network design model?

(5 marks)

d) Explain different data backup techniques? Which backup technique you will use to back up the research repository and why? *(10 marks)*

e) The college wants wireless coverage across the campus to provide in-building and outdoor Wi-Fi coverage, Wi-Fi service with good capacity in the lecture rooms, Wi-Fi access in student accommodation and lecturer residences. What are the key components need to be considered in design phase to meet the requirements? *(10 marks)*

f) The college has three departments with 50 active users in each department. There are total of 350 active users in the college including the students. Draw a logical network diagram. What IP class will you use and how are you going to segment each department in different collision domain? *(10 marks)*