ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2013
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION PAPER for *IT 4 YEARS*

Date	: 14 October 2013
Total Marks	: 100
Examination Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to examination time)

GENERAL INSTRUCTIONS:

1. Write your Roll Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is being provided 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 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 two Case Studies. Choose only ONE case study and answer the questions under your choice.
4. 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 any or correct Section, Part and Question Number will NOT be evaluated and no marks would be awarded.
5. Begin each Section and Part in a fresh page of the Answer Booklet.
6. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
7. Use of any other paper including paper for rough work is not permitted.
8. You are required to hand over the Answer Booklet to the Invigilator before leaving the examination hall.
9. This paper has **11** printed pages in all, 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 the correct answer chosen 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. N-computing is based on which of the following class of client-server applications?

A. host-based processing
B. server-based processing
C. client-based processing
D. cooperative processing

2. Which of the following is termed as NAT (network address translation) overload?

A. PAT (port address translation)
B. Static NAT
C. Dynamic NAT
D. Proxy NAT

3. Which of the following languages was initially created as Transformation Language for Style Sheets?

A. XSTL
B. XML
C. XQuery
D. XPath

4. The CPU does which of the following when it receives an interrupt from an I/O device?

A. Halts for a predetermined time.
B. Branches off to the interrupt service routine immediately.
C. Branches off to the interrupt service routine after completion of the current instruction.
D. Hands over control of address bus and data bus to the interrupting device.

5. Which of the following is NOT a characteristic of Enterprise Resource Planning (ERP)?

A. It attempts to automate and integrate majority of the business processes.
B. It shares common data and practices across the enterprise.
C. It is inexpensive to implement.
D. It provides and access information in a real-time environment.

6. Which of the following is NOT an application area of Web Mining?

A. Click stream analysis.
B. Information filtering.
C. Crime fighting on the Internet.
D. Online transaction processing.

7. What can analysts detect by using data flow diagram?

A. Task duplication
B. Unnecessary delays
C. Task overlapping
D. All of the above.

8. Many causes of software crisis can be traced to mythology based on:

A. Management Myths
B. Customer Myths
C. Practitioner Myths
D. All of the above

9. Which of the following is NOT a feature of UML?

A. The entire language is made up of simple and straightforward notations.
B. It describes all important aspects of a system.
C. It can be used for both large projects and scaled down to small projects.
D. It not controlled by standards and allows vendor lock-in.

10. Which of the following methods provide secure transmission of email?

A. TLS
B. HTTPS
C. IPSec
D. PGP

11. If the In-order and Post-order traversal of a tree is given as:
In-order: j e n k o p b f a c l g m d h i
Post-order: j n o p k e f b c l m g h i d a
The Pre-order traversal of the tree is:

A. a b f e j k n o p c d g l m h i
B. a b c d e f j k n o p g l m h i
C. a b e j k n o p f c d g l m h i
D. j e n o p k f b c l m g h i d a

12. The following program segment in 'C' language will result in which output?

```
sum (n)
{
        if (n<1) return n;
        else return (n + sum(n-1));
}
main ( )
{
        printf ("%d", sum(5));
}
```

A. 10
B. 14
C. 15
D. 16

13. Working software is not available until late in the process in which of the following?

A. Waterfall model
B. Prototyping model
C. Incremental model
D. Evolutionary Development model

14. Which of the following set of Unix commands will always display "BHUTAN" ?

A. export title = BHUTAN; echo $title
B. title = BHUTAN; export $title ; sh –c "echo $title"
C. title = BHUTAN; export title ; sh –c "echo $title"
D. title = BHUTAN; echo $title

15. Which of the following ensures that a value that appears in one relation for a given set of attributes also appears for a certain set of attributes in another relation?

A. Logical Integrity
B. Referential Integrity
C. Domain Integrity
D. Data Integrity

16. Which of the following logic family dissipates the minimum power?

A. DTL
B. TTL
C. ECL
D. CMOS

17. The time complexity of an efficient algorithm to find the longest monotonically increasing subsequence of *n* numbers is:

A. O (n)
B. O (n log n)
C. O (n^2)
D. None of the above

18. Although the spatial compression in MPEG is similar to JPEG, the temporal compression in MPEG removes which of the following frames?

A. Temporal
B. Voice
C. Spatial
D. Redundant

19. The two color systems- the HSV and HLS are:

A. Hue, Saturation, Value and Hue, Lightness, Saturation.
B. High, Standard, Value and High, Lightness, Saturation.
C. Highly, Saturated, Value and Highly, Lightened, Saturation.
D. Highly, Standard, Value and Hue, Lightness, Saturation.

20. Information related to the number of bytes that may be sent starting at the byte acknowledged is found in which field of the TCP header?

A. TCP header length
B. Window size
C. Acknowledgement number
D. Urgent pointer

21. Given the IP address 202.144.157.65 and the subnet mask 255.255.255.224, which of the following would be the subnet address?

A. 202.144.157.32
B. 202.144.157.64
C. 202.144.157.65
D. 202.144.157.224

22. Which of the following set of gates is best suited for 'parity' checking and generation?

A. AND, OR, NOT
B. NAND, NOR
C. EX-OR, EX-NOR
D. None of the above

23. Which of the following is prevented by using Preemption and Transaction Rollback?

A. Unauthorized usage of data file
B. Deadlock situation
C. Data manipulation
D. File preemption

24. Linked Lists are not suitable for which of the following?

A. Binary Search
B. Polynomial Manipulation
C. Insertion
D. Radix Sort

25. The number of states in a minimal deterministic finite automaton corresponding to the language L = { a^n | n≥4 } is:

A. 3
B. 4
C. 5
D. 6

26. The number of eight-bit strings beginning with either 111 or 101 is:

A. 64
B. 128
C. 265
D. None of the above

27. What is true for the given productions of a grammar:

S→ aA| aBB;
A→aaA |λ ;
B→ bB| bbC;
C→ B

A. The language corresponding to the given grammar is a set of even number of a's.
B. The language corresponding to the given grammar is a set of odd number of a's.
C. The language corresponding to the given grammar is a set of even number of a's followed by odd number of b's.
D. The language corresponding to the given grammar is a set of odd number of a's followed by even number of b's.

28. Improving processing efficiency or performance or reconstructing of software to improve changeability is known as:

A. Corrective maintenance
B. Perfective maintenance
C. Adaptive maintenance
D. Code maintenance

29. Which of the following is true given the two function declarations:
(i) int * f ( ) and (**ii) int (*f) ( )**

A. Both are identical.
B. The first is a correct declaration and the second is wrong.
C. Both are different ways of declaring pointer to a function.
D. The first declaration is a function returning a pointer to an integer and the second is a pointer to a function returning an integer.

30. If user A wants to send an encrypted message to user B. The plain text of A is encrypted with which of the following?

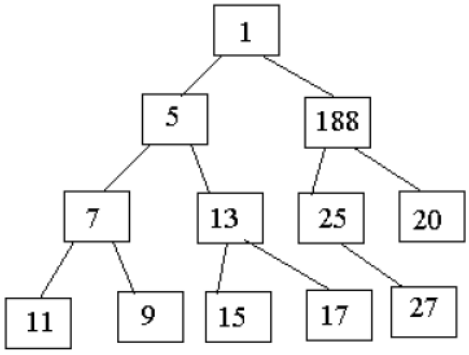
A. Public Key of user A
B. Public Key of user B
C. Private Key of user A
D. Private Key of user B

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. Traverse the following binary tree in :

i. preorder (1 mark)
ii. inorder (1 mark)
iii. and postorder (1 mark)



iv. Evaluate the following postfix expression using a stack. (2 marks)

6 2 3 + - 3 8 2 / + * 2 $ 3 +

2. What is normalization? State one reason why a database must be normalized? (2 marks)

Given a relation, **R= (A,B,C,D,E)** with the following functional dependencies:

{BC ⟶ ADE, D ⟶ B}

i. Find all candidate keys. (1 mark)
ii. Indentify the best normal form that **R** satisfies. (1 mark)
iii. If the relation is not in BCNF, decompose it until it becomes BCNF. (1 mark)

3. What is meant by multiplexer and de multiplexer? (2 marks)
Draw the block diagram, truth table and logic diagram of a **4 to 1** line multiplexer. (3 marks)

4. State two benefits of subnetting a network? (2 marks)

i. How many subnets and hosts per subnet can you get from the network 172.31.0.0/28? (2 marks)

ii. What is the last valid host on the subnetwork 172.26.106.0/24? (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

Kuenphen Technical Staff Management (KTSM)

Kuenphen Technical Staff Management (KTSM) is a unique type of temporary staffing agency. Many organizations today hire highly skilled technical employees on a short-term, temporary basis to assists with special projects or to provide a needed technical skill. KTSM negotiates contracts with its client companies in which it agrees to provide temporary staff in specific job categories for a specific cost. For example, KTSM has contract with a mining company, in which it agrees to supply geologists with at least a master's degree for Nu. 15000 per week. KTSM has contracts with wide range of companies and can place almost any type of professional or technical staff members, from computer programmers to geologists to architects.

When a KTSM client company determines that it will need a temporary professional or technical employee, it issues a staffing request against the contract it had previously negotiated with KTSM. When a staffing request is received by KTSM's contract manager, the contract number

referenced on the staffing request is entered into the contract database. Using information from the database, the contract manager reviews the terms and conditions of the contract and determines whether the staffing request is valid. The staffing request is valid if the contract has not expired, the type of professional or technical employee requested is listed on the original contract, and the requested fee falls within the negotiated fee range. If the staffing request is not valid, the contract manager sends the staffing request back to the client with a letter stating why the staffing request cannot be filed, and a copy of the letter is filed. If the staffing request is valid, the contract manager enters the staffing request into the staffing request database, as an outstanding staffing request. The staffing request is then sent to the KTSM placement department.

In the placement department, the type of staff member, experience, and qualifications requested on the staffing request are checked against the database of available professional and technical staff. If a qualified individual is found, he or she is marked "reserved" in the staff database. If a qualified individual cannot be found in the database or is not immediately available, the placement department creates a memo that explains the inability to meet the staffing request and attaches it to the staffing request. All staffing requests are then sent to the arrangements department.

In the arrangement department, the prospective temporary employee is contacted and asked to agree to the placement. After the placement details have been worked out and agreed to, the staff member is marked "placed" in the staff database. A copy of the staffing request and a bill for the placement fee is sent to the client. Finally, the staffing request, the "unable to fill" memo (if any), and a copy of the placement fee bill is sent to the contract manager. If the staffing request was filled, the contract manager closes the open staffing request database. If the staffing request could not be filled, the client is notified. The staffing request, placement fee bill, and "unable to fill" memo are then filed in the contract office.

Required:

a. Develop a use case for each of the major processes in the KTSM scenario. (10 marks)

b. Create the context diagram for the system described above. (5 marks)

c. Create the DFD fragments for each of the use cases outlined in part a, and then combine them into the Level-0 DFD. (15 marks)

d. Create a Level-1 DFD for the most complicated use case. (10 marks)

e. Create an Entity Relationship Diagram (ERD) for the KTSM System. Clearly list the entities, their attributes and identifiers, and the relationships. (10 marks)

CASE 2

Architecture Design for Bhutanese Music Online System.

A Bhutanese music company is interested in developing a digital music download system and has carried out the requirements analysis. The selected Nonfunctional Requirements for the company based on the analysis undertaken is printed in the Table given below. Based on these given requirements and making assumptions wherever necessary, you have to achieve the following tasks:

Required:

a. Create an architecture design which is best suited to meet the requirements of the online music system. State your reasons and justify options. (15 marks)

b. Specify the different software (Operating System and special software) that would be required for various components of the architecture such as client, web server, application server, database server, etc. (15 marks)

c. Specify the different hardware that you would deploy for the various components of the architecture that you have discussed above. Justify each of your hardware specification. (10 marks)

d. Specify the network technologies and security features (hardware and software) that you recommend for the above architecture and how to meet the cultural and political requirements (if any) of the proposed system. (10 marks)

Table showing selected Nonfunctional Requirements for the Online Music System:

1. Operational Requirements	
Technical Environment	1.1 The system will work over the web environment with a web a web browser and an audio player. 1.2 Customers will need only a web browser and audio player on their desktops.
System Integration	1.3 The Internet system will read information from the main music information database which contains basic information about tracks (e.g., title, artist, ID number, price).The Internet system will not write information to the main music information database. 1.4 The Internet system will read and write to the main customer database.
Portability	1.5 The system will need to remain current with evolving Web standards, especially those pertaining to music formats.
Maintainability	1.6 No special maintainability requirements are anticipated.

2. Performance Requirements	
Speed	2.1 Response time must be less than 7 seconds. 2.2 Download speeds must be maintained above the industry norm. 2.3 Customers must be able to specify the type of Internet connection used for the download.
Capacity	2.4 There will be a maximum of 100 simultaneous users at peak times. 2.5 The system will support streaming audio to up to 50 simultaneous users.
Availability and Reliability	2.6 The system should be available 24/7. 2.7 The system shall have 99% uptime performance.
3. Security Requirements	
System Value	3.1 No special system value requirements are anticipated.
Access Control	3.2 Customers can access their accounts with username and password.
Encryption/Authentication	3.3 Customer payment information must be transmitted securely.
Virus Control	3.4 Downloads must be verified as virus free.
4. Cultural and Political Requirements	
Multilingual	4.1 Language option for Dzongkha anticipated.
Customization	4.2 No special customization requirements anticipated.
Unstated Norms	4.3 No special unstated norms requirements anticipated.
Legal	4.4 No special legal requirements are anticipated.