ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2012
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION PAPER for
COMPUTER SCIENCE & ENGINEERING

Date	: 14 October 2012
Total Marks	: 100
Examination Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to examination time)

READ THE FOLLOWING INSTRUCTIONS CAREFULLY:

1. Write your Roll Number clearly on the Answer Booklet in the space provided.

2. The first 15 minutes is being provided to check the number of pages, printing errors, clarify doubts and to read the instructions. You are NOT PERMITTED TO WRITE during this time.

3. Use either Blue or Black ink pen or ball point pen for the written part and Pencils for the sketches and drawings.

4. All answers should be written on the Answer Booklet provided. Candidates are not allowed to write anything on the question paper or any other materials.

5. All answers must be labeled with appropriate question numbers (Section, Question and sub-Question Numbers wherever applicable). Unlabelled answers will not be assessed.

6. This paper is divided into two sections-namely SECTION A and SECTION B.

7. SECTION A consists of two parts: Part I and Part II.

    Part I consists of 30 Multiple-Choice Questions carrying one (1) mark each and is compulsory. The answer of your choice should be clearly written in whole along with the question and option number on your answer booklet. Eg. 31(c).

    Part II consists of four (4) short answer questions of five (5) marks each and all questions are compulsory.

8. SECTION B consists of two Case Studies. Choose only ONE case study and answer the questions under your choice. Each case study carries fifty (50) marks in total.

9. This Paper consists of ELEVEN (11) pages including this Instruction page.

SECTION – A
(50 Marks)

PART I - Multiple Choice Questions (30 Marks)

Multiple Choices: Select the most appropriate answer. There is only one correct answer in the list. Answers that contain more than one selection will not be graded. Choose only **ONE** answer.

Mark the letter (A, B, C or D) corresponding to the correct answer against the question number in your **Answer Booklet.**

Example:

Q. **What does RAID stand for?**

    A.   Rectangular Arrangement of Initialized Data
    B.   Random Array of Inexpensive Disks
    C.   Redundant Array of Inexpensive Disks
    D.   Random Array of Initialized Data.

Answer: Q – C

1. Design recovery from source code is done during :

    A.   reverse engineering
    B.   re-engineering
    C.   reuse
    D.   all of the above

2. BCC in the internet refers to :

    A.   Black carbon copy
    B.   Blind carbon copy
    C.   Blank carbon copy
    D.   Back carbon copy

3. Which of the following is a bad example of recursion?

    A.   Factorial
    B.   Fibonacci numbers
    C.   Tower of Hanoi
    D.   Tree traversal

4. What is the decimal equivalent of BCD 11011.1100 ?

      A.   22.0
      B.   22.2
      C.   20.2
      D.   21.2

5. Which data management language component enabled the DBA to define the schema components?

      A.   DML
      B.   Sub-schema DLL
      C.   Schema DLL
      D.   All of the above

6. In order to allow only one process to enter its critical section, binary semaphore are initialized to :

      A.   0
      B.   1
      C.   2
      D.   3

7. Technician A says that IPv6 supports broadcasting, while Technician B says that a MAC address is 48 bits.

      A.   Technician A is correct
      B.   Technician B is correct
      C.   Both Technician A and Technician B are correct
      D.   Both Technician A and Technician B are incorrect

8. Which of the following specifications for a member of a class allows access only to methods of the class ?

      A.   private
      B.   public
      C.   protected
      D.   derive

9. What is the most appropriate data structure to implement a priority queue ?

      A.   Heap
      B.   Circular array
      C.   Linked list
      D.   Binary tree

10. **Top-down design does not require :**

    A. Step-wise refinement
    B. Loop invariants
    C. Flow charting
    D. Modularity

11. **End-to-End connectivity is provided from Last-to-Last in:**

    A. Network layer
    B. Transport layer
    C. Session layer
    D. Data link layer

12. **The idempotent law in Boolean algebra says that :**

    A. $\sim(\sim x) = x$
    B. $x + x = x$
    C. $x + xy = x$
    D. $x(x + y) = x$

13. **An example of a public key encryption is :**

    A. Caesar cipher algorithm
    B. DES algorithm
    C. AES algorithm
    D. Knapsack algorithm

14. **Which of the following routing protocols use only hop counts to measure distance?**

    A. OSPF
    B. EIGRP
    C. RIP
    D. BGP

15. **Assembler program is :**

    A. Dependent on the operating system
    B. Dependent on the compiler
    C. Dependent on the hardware
    D. Independent of the hardware

16. **A superkey for an entity consists of :**

    A. One attribute only
    B. At least two attributes
    C. At most two attributes
    D. One or more attributes

17. **In software development, value adjustment factors include the following among others:**

    A.   The criticality of the performance and reusability of the code.
    B.   Number of lines of code in the software.
    C.   Number of technical manpower and hardware costs.
    D.   Time period available and the level of user friendliness

18. **Which of the OSI layers, is ARP associated with?**

    A.   Session and transport layers
    B.   transport and network layers
    C.   network and data link layers
    D.   data link and physical layers

19. **Aggregate functions in SQL are :**

    A. GREATEST, LEAST and ABS
    B. SUM, COUNT and AVG
    C. UPPER, LOWER and LENGTH
    D. SQRT, POWER and MOD

20. **System development cost estimation with use-cases is problematic because :**

    A. of paucity of examples
    B. the data can be totally incorrect
    C. the expertise and resources available are not used
    D. the problem is being over simplified

21. **Which of the following application layer protocols use UDP ?**

    A. TFTP
    B. POP
    C. SMTP
    D. HTTP

22. **When a language has the capability to produce new data type, it is said to be :**

    A. extensible
    B. encapsulated
    C. overloaded
    D. none of the above

23. **The approach to software testing is to design test cases to :**

    A. break the software
    B. understand the software
    C. analyse the design of sub processes in the software
    D. analyse the output of the software

24. If the executing program size is greater than the existing RAM of the computer, it is still possible to execute the program if the OS supports :

    A. multitasking
    B. virtual memory
    C. paging system
    D. none of the above

25. An example of a data mining algorithm which uses squared error score function is :

    A. CART algorithm
    B. back propagation algorithm
    C. a priori algorithm
    D. vector space algorithm

26. A multiplexer is a logic circuit that :

    A. accepts one input and gives many outputs
    B. accepts many inputs and gives many outputs
    C. accepts many inputs and gives one output
    D. accepts one input and gives one output

27. Given a binary tree whose inorder traversal is EICFBGDJHK and preorder traversal is BCEIFDGHJK. The post order traversal of the above binary tree is :
    A. IEFCJGKHDB
    B. IEFCGJKHDB
    C. IEFCGKJHDB
    D. IEFCGJKDBH

28. All the following are examples of real security and privacy risks except :
    A. Hackers
    B. Spam
    C. Viruses
    D. Identity theft

29. The statement: *printf ("% d", 10 ? 0 ? 5 :1 :12) ;* will print :
    A. 10
    B. 0
    C. 12
    D. 1

30. The cost of the network is usually determined by :
    A. time complexity
    B. switching complexity
    C. circuit complexity
    D. none of the above

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. **a.** What is the most popular kind of database today? (1 Mark)

   b. Provide three examples of products that are based on this technology. (3 Marks)

   c. What is referential integrity, and how is it implemented in a relational database? (1 Mark)

2. **a.** Explain three important user interface design principles. (3 Marks)

   b. What is whitespace and why is it important? (1 Mark)

   c. Under what circumstances would you use a drop-down menu versus a tab menu? (1 Mark)

3. **a.** Write briefly on any three requirements that memory management is intended to satisfy. (3 Marks)

   b. Why is it not possible to enforce memory protection during compile time? (1 Mark)

   c. What is the difference between page and frame? (1 Mark)

4. With regard to C Programming, answer the following questions:

   a. With an example, explain *switch* statement and significance of *break* in *switch* block. (3 Marks)

   b. What is the characteristic of *sizeof ( )* operator? (1 Mark)

   c. What do you understand by the term *spaghetti code* ? (1 Mark)

SECTION – B
(CASE STUDY)

Answer ANY ONE (1) CASE Study. Each Case study carries 50 marks.

1. CASE STUDY: Thimphu Hospital Automation

Consider the operation of JDWNR Hospital in Thimphu. Patient's data are stored and retrieved. Further, data about the various types of and number of wards/beds/operation theatres available and allotment of wards to patients are also maintained. The hospital authorities are interested in computerizing this information.

The hospital has three types of operation theatres: A, B and C, respectively used for major, minor and small operations, respectively. Wards are of two types: general and special. General wards have capacities of 10 and 20 beds while special wards are either single or double beds. The hospital also has a maternity ward with 25 rooms, each of which can accommodate 2 beds. The hospital has 5 general wards of capacity 10 and 5 general wards of capacity 20. It has 10 special wards with 2 beds each and 10 special wards with single bed. Moreover, the hospital has an intensive care unit with a 5-bed capacity.

The charges are given in the table below (Nu.).

General Ward		Special Ward		Maternity Ward
10 - Bed	20- Bed	Double	Single	
200	150	300	400	250

Intensive care unit (ICU) costs Nu. 1000/- per day.

The doctor notes down the clinical details on the patient's card, which contains the following details:

The name of the patient, address, date of visit, doctor's name etc.

If the patient has to be admitted, other details such as bed no., ward no., type, and date of admission are noted. If the patient has been recommended or desires a special ward but is currently not available, he may be admitted in a general ward and later transferred when a bed is available.
Operation costs are not fixed and are determined on a case by case basis. When the patient is discharged, the bed charges should be computed. To this should be added costs of medicine, treatment, consultation fees, operation charges if any, and laboratory charges. Assume that another subsystem of hospital information system gives you these details and is available.

Your system will have to compute equipment charges for those used by patients. Whenever equipment is used by the patient, the details are noted. Assume that the available equipment are X-ray machine, infrared radiation generation machine, scanner, ultrasound machine. The charges

are based on number of exposures incase of X-ray at Nu.50 per exposure. The others are based on number of hours of usage, at Nu. 100, 150, and 200, respectively.

All the above costs are to be added and presented in the final bill. Your system should keep track of patient's data, history, ward/equipment usage to calculate other costs, ward/bed allotted or otherwise, operation theatre used.

The following problems are encountered by the hospital:

1. Currently the hospital is not able to keep track of the free/allotted wards/beds and their details due to frequent shifting of the patients, difficulty in tracking both ward-wise and patient-wise.
2. Patient's data, especially history is also difficult to extract.

Your system should be able to provide the following information:

1. Details of a patient such as when a patient was admitted, his or her charges, facilities used, date of discharge, etc.
2. State of beds/wards, free/occupied etc.

Required:

a. Given the above problems and requirements of the system, draw the context diagram for the new system.   (5 Marks)

b. Draw the logical DFD for the new system.   (10 Marks)

c. Explain the process modeling for calculating the final bill.   (10 Marks)

d. Draw the E-R diagram for the new system.   (10 Marks)

e. Design the architecture for the system and also recommend what hardware and software specifications would be used.   (10 Marks)

f. Provide a snapshot of the user interface that might be designed for the above system.
                                                                                           (5 Marks)

2. CASE STUDY: Network Design Project

You are interested in opening your own sports and hobby shop, Ghakyed Games, in a suburban area of Thimphu. You need to design and build a network and computing solution. You have done some initial planning and you will start with one shop at Olakha and one remote warehouse at Babesa (but you plan to add another shop across town, probably at Taba within one year). Your shop will sell new and used sports and gaming products. You have identified the following requirements for your network:

1. A computer network that will connect two office computers and one computer used for Point-of-Sale (POS) services. You also want one computer in the lobby/shop where patrons can research upcoming sports and gaming products. Eventually the two offices will need to connect into one cohesive network, sharing POS services and other critical company information. For now, you need to connect the Olakha shop and office computers and connect to one computer in the warehouse which is located at the end of the expressway (about two miles away) at Babesa.

2. To save money, you need to have a Voice over IP solution between the store and the warehouse to check with warehouse personnel regarding stock, etc. This VOIP solution must be an inexpensive solution and provide messaging, voice and voicemail capabilities.

3. The network must provide adequate security for all of the company communications and documents (especially sensitive sales documents).

4. The network must be fast and have additional capacity as the company grows.

5. Provide for centralized printing among the three computers in the office and be able to print invoices from the store to a remote printer in the warehouse.

6. Support the eventual addition of the other shop to the network.

7. Provide customers with a general information Web site and a secure Web site where clients can buy services, and products.

8. Provide for limited downtime (48 hour downtime maximum).

9. Provide for centralized management and control of the computers at the two locations (shop and warehouse), so that an off-site consultant can maintain the network.

10. Provide for long-term cost effectiveness.

11. Provide a suite of software tools for the employees to effectively communicate.

12. Low cost is a very important factor and should be a critical part of your network design.

Additional information:

1. The company does not have any equipment. Your plan should include a complete network and computer system that meets these requirements and future expansion plans.

2. The shop and warehouse locations are within a two mile radius of each other. The locations are within a suburban area that has current technological infrastructures and related technology offerings. The shop will need a simple sales system and print services for invoices.

Required:

a. **Given the above requirements and information submit a network design proposal.**

   Complete your proposal including costs for computing equipment, network infrastructure, network servers, printers, and related hardware, software, and accessories. Include as much detail as possible as well as justification as to your selections.

   Diagram and explain your physical network and computer design as well as the logical network design (server installation, domain layout, etc.). As you are a small business, cost is a major factor and should be minimized.

   (50 Marks)

*************************** END OF QUESTION PAPER ***************************