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

PAPER III: SUBJECT SPECIALIZATION PAPER for IT 4 YEARS

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 nine (9) pages including this Instruction page.

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 Sheet against the question number. E.g. 31 (c). Each question carries ONE mark.

1) Which of the following is the most advanced data transmission technique for Wide Area Networks
   a) ATM
   b) Packet Switching
   c) Circuit Switching
   d) Frame Relay

2) The minimum size of a TCP header is
   a) 8 bits
   b) 20 bytes
   c) 20 bits
   d) 60 bytes

3) The following is **TRUE** when the SYN flag bit in a TCP header is set to **1**
   a) Payload field is encrypted
   b) Data transfer is complete
   c) The sequence number value is the starting sequence number
   d) None of the above

4) Which of the following TCP segment fields takes care of flow control
   a) Source Port
   b) Destination Port
   c) Data Offset
   d) Window Size

5) An approach for error control involving detection of errors followed by further processing of the received information that attempts to correct the errors is known as
   a) ARQ
   b) FEC
   c) FSK
   d) CRC

6) In an IPV4 header the fields *Destination Address* and *Protocol* represents
   a) Destination port number and UDP protocol
   b) Destination Host IP address and the Higher layer protocol using the IP protocol
   c) MAC address of the host and the ARP protocol
   d) None of the above

7) Spectrum of a signal is
   a) The range of frequencies it contains
   b) The maximum amplitude of the signal
   c) The fundamental frequency of the signal
   d) All of the above

8) The following are all signal transmission impairments EXCEPT
   a) Attenuation
   b) Delay Distortion
   c) Noise
   d) Frequency Modulation

9) Which of the following guided transmission media is not affected by electromagnetic field
   a) Optical Fiber
   b) Coaxial Cable
   c) CAT 3 UTP
   d) CAT 5 UTP

10) Microwave frequencies are frequencies falling in the range
   a) 30MHz-1GHz
   b) 1GHz-40GHz
   c) 100Hz-1KHz
   d) 1KHz-100MHz

11) IEEE 802.11 is a
   a) High level programming language
   b) Wireless networking standard
   c) Ethernet LAN standard
   d) Microprocessor

12) Which of the following is not a UML Behavioral Diagram
   a) Activity diagram
   b) State machine diagram
   c) Use case diagram
   d) Class diagram

13) A *Fork* in a UML activity diagram depicts
   a) Decision making
   b) Inheritance
   c) Beginning of a parallel activity
   d) End of a parallel activity

14) Encapsulation in OOP means
   a) Packaging method and the data in an object and giving access to the object data through interfaces
   b) Packaging the method and the data in an array
   c) Instantiating a class by using a constructor
   d) Ability of objects to provide context when methods or operators are called on the object.

15) Which of the following statements is **NOT TRUE** about Java abstract classes
   a) Abstract classes cannot be instantiated
   b) An abstract class must be defined using the *Abstract* keyword
   c) An abstract class must have at least one abstract method
   d) A non abstract subclass does not need to provide implementation for all the inherited abstract methods.

16) Which MSDOS command displays the directory list including files in tree structure
   a) Dir/s/f
   b) Tree/f
   c) Tree/s/f
   d) Dir/F

17) Private data members or member functions of a C++ class are accessible to
   a) All the functions in the program
   b) All the functions in the program with void return type
   c) Any member function of the class
   d) All of the above

18) _____is a measure of the lack of uniqueness of data in a table when working with indexes in database
   a) Selectivity
   b) Density
   c) Index depth
   d) Composite index

19) In Java computing, an applet
   a) Performs various tasks depending on the need
   b) Runs on its own whenever computer is powered up
   c) Is a small application that performs one specific task and runs within the scope of a larger program
   d) All of the above

20) Which of the following is an asymmetric key cryptographic algorithm
    a) DES
    b) 3DES
    c) AES
    d) RSA

21) If we apply DeMorgan's theorem to the $\overline{XYZ}$, the result is
    a) $X + Y + Z$
    b) $\overline{X + Y + Z}$
    c) $X(Y + Z)$
    d) $\bar{X} + \bar{Y} + \bar{Z}$

22) Which of the following is **NOT** an element of Web service platform
    a) UDDI
    b) SOAP
    c) WSDL
    d) CORBA

23) The following XML encoding is
    <customer>
    <name>Pema </name>
    <customerid>12</customerid>
    </customer>
    a) Element centric
    b) Comma separated
    c) Attribute centric
    d) None of the above

24) Hopcroft's algorithm is
    a) A deterministic finite automation minimization algorithm
    b) A non- deterministic finite automation minimization algorithm
    c) A routing algorithm
    d) CPU scheduling algorithm

25) The post order traversal of a binary tree is DEBFCA. The pre order traversal of the binary tree is
    a) ABFCDE
    b) ADBFEC
    c) ABDECF
    d) ABDCEF

26) Which of the following is the worst case performance for binary search algorithm
    a) O(n)
    b) O(log n)
    c) O(n log n)
    d) $O(n^2)$

27) Which of the following data structures cannot hold non-homogeneous content?
   a) Structures
   b) Classes
   c) Arrays
   d) All of the above

28) A function that calls itself is a

   a) Inline function
   b) Overloaded function
   c) Nested function
   d) Recursive function

29) Which of the following is not a valid C++ data type

   a) real
   b) int
   c) float
   d) double

30) Run Time Memory Allocation is
   a) Static memory allocation
   b) Physical memory allocation
   c) Dynamically allocating memory
   d) Virtual memory allocation

PART – II : Short Answer Questions (20 marks)

Answer ALL the questions. Each question carries 5 marks.

1) What do you mean by static/early binding? How is it different from dynamic/late binding? (5 Marks)

2) Transmission Control Protocol (TCP) is said to be a connection oriented reliable data transmission protocol. What does it mean? Briefly discuss how a typical TCP data transfer takes place. (5marks)

3) Briefly discuss how public key encryption work.(5 Marks)

4) What is garbage collection in the context of programming languages? Comment on its benefits and the contexts in which it arises giving examples.(5 marks)

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

Micro Credit/Loans are small amount loans given for starting up or developing small and medium enterprises. The money to be given on loan can, unlike traditional loans, come from many money lenders. The idea is to use information technology to bring the lenders together. Borrowers are people who want to start up small businesses or people who want to develop their existing small businesses.

A small database system to manage this credit facility is to be developed and the following information has been given for developing the database system:

    i.   Borrower and lender details: name and address.

    ii.   Loan request from borrowers which contains

        a) Information about when the loan should at latest be granted

        b) The total amount being requested in Ngultrums

        c) Payback period

    iii.   A borrower can have more than one request and more than one loan at a time. But a borrower cannot make more than one loan request on the same day.

    iv.   The loan is paid through an "agent" who has a name and an address

    v.   The borrower chooses when he or she will make a payment. Every payment must be registered in the database with an amount and a date. The lenders share the repayment based on the ratio of their contribution.

    vi.   The borrower can make multiple repayments on the same day, but not more than one repayment per loan per day.

    vii.   If the loan is not repaid before the agreed deadline, a new date is agreed. The database must not delete the old deadline, but save the history

    viii.   Each lender can create a "Risk Profile" for each borrower, which is a number between 0 and 50 that determines the lender's evaluation of the risk of lending money to that person. 0 depicts no risk and 50 depicts high risk.

Questions

1. Provide an E-R model for the information given above. State all the assumptions if you make any. The E-R model must capture all properties such as entity attributes, relationships, cardinalities, etc.(10 Marks)

2. Provide SQL statements to create at least two of the relations/tables. (Make reasonable assumptions about data types), and state the relation schemas for the other relations.(10 Marks)

3. If the following relation schema/table is used to store data on the Repayments on loans

Repayment(borrower_id,name,address,loanamount,requestdate,repayment_date,request_amount)

     (a) State a candidate key for the Repayment table. (5 Marks)
     (b) Normalize the Repayment table to BCNF. (5 Marks)

4.

     (a) Write an SQL statement that returns all the tuples with information on Repayments from the borrower with borrower_id equal to 82, and where the lent amount exceeds NU1500.(5 Marks)
     (b) Write an SQL statement that finds the total repayment amount for each address. (5 Marks)

5. What do you mean by referential integrity constraint in databases? What are some advantages of enforcing referential integrity constraints in a database implementation? If you were to use a RDBMS solution what solution will you choose to implement the Loan database? State your reasons. (10 Marks)

CASE 2

NewBytes is a private IT and business solutions firm with 100 plus employees. In a bid to modernize and automate public service delivery, the firm has recently been awarded the work of providing online Government to Citizen Services(G2C) from the community centers (CCs) established in each of the Gewogs throughout the country by the Ministry of Science and Technology. The online systems for the public services are hosted in respective government agencies in Thimphu, and are owned by the agencies. NewBytes will be delivering the services to the general public on behalf of the agencies through the CCs. These CCs will serve as one stop shop for any kind of Government to Citizen Services, and are equipped with computers, printers, fax, telephone, digital camera, etc.

Every government agency delivering public services has their own data center/server located in their own premises. All these government agencies hosting the online systems are connected to a Wide Area Network (WAN) backbone. The 205 CCs are not connected to the Wide Area Network. The CCs will have to be connected to the agency datacenters/servers via Internet or any other feasible connectivity facility in the interim period to be able to access the online systems for availing different G2C Services from the agencies in Thimpbu. .However, the Wide Area Network will be extended to all the Gewogs in 12 months time which will enable the CCs to also use the WAN infrastructure.

NewBytes plans to deliver all the services efficiently from all the 205 CCs with speed and quality and customer friendliness. Every CC will have at least one operator.

A central control unit will be set up at the Firm's head office in Thimphu to monitor the connectivity status of every CCs in real time. The control unit will also have features to check status of the agency systems.

Newbytes also have been told by the Ministry to prepare a long term plan to gradually centralize all the datacenters into a state of the art datacenter.

The firm also plans to have a website to share information with the public on any new developments regarding its businesses. All the employees of the firm will have company email address with the newly registered **newbytes.com.bt** domain.

You have been recruited as the IT manager of NewBytes and assigned the task of developing a clear and concise proposal for the project. You have been told that you will be supported by a dedicated team of young IT professionals.

Questions

1. Prepare a clear work plan that will guide you and your project team for the next 6 months. The work plan must clearly show the outputs you intend to achieve at the end of six months. These outputs must be supported by activities.(10 marks)

2. How would you plan to connect all the 205 CCs to the different government agency datacenters/servers in the interim period before the WAN extension reaches the gewogs? How will your connectivity set up change after the WAN gets extended to the gewogs? Explain with the help of diagrams for both the cases. (10 marks)

3. The long term plan of the Ministry is to set up a common data center for all the services. Provide clear strategies and options to the Ministry of how this could be achieved. Do we have any datacenter establishment in the country? (10 marks)

4. How will you set up the control unit to monitor both the CCs and the agency servers? What software and hardware facilities must be put in to place to achieve this?(10 Marks)

5. You are also required to set up a mail and a web server. What are the Application and Transport layer protocols used by these services? Briefly discuss how these protocols function.(10 marks)