Mawlana Bhashani Science and Technology University

Department of Information and Communication Technology

1st Year 2nd Semester B.Sc. (Engg.) Final Examination 2021

Course Title: Programming with C++ Course Code: ICT-1203

Marks: 70 Time: 3 Hours

Answer any FIVE questions. Maintain sequences while answering.

1. a) What is a structure? How do you define a structure? 4
   b) What is the difference between a structure and a class? 4
   c) Write a program to illustrate an array of structures. Also, illustrate input/output for the structures. 6

2. a) What is the difference between constructor overloading and function overloading? 4
   b) What is a copy constructor? Why do we pass an object by reference to the copy constructor? 4
   c) Define a class named Triangle as the following instruction: 6
      i. Data members are firstSide, secondSide, and thirdSide.
      ii. Define a constructor for the class that asserts that the sum of any two sides to be greater than the third one.
      iii. Accessor member functions are getSides, getPerimeter, and getArea. To find the perimeter and area of a triangle, use the following.
      perimeter = a + b + c, area = sqrt ((p) * (p - a) * (p - b) * (p - c)) // p = perimeter / 2

3. a) What is a static function member of a class? Write an illustrative code for the declaration of a static function member of a class. 5
   b) What is pure virtual function? How it is different from all other functions? 5
   c) Identify and solve the error in the following program. 4

```
#include<iostream.h>

class Room{
      int width, height;
      void setValue(int w, int h){
            width = w;
            height = h;
      }
};

void main(){
      Room objRoom;
      objRoom.width = 12;
}
```

4. a) What are the main advantages of inheritance? Illustrate an example of resolving ambiguity in multiple inheritance. 5
   b) A derived class D is derived from two base classes B1 and B2 which have one private data member each and constructor functions. The derived class D also has a private member. How would you define the constructor function for class D? 4
   c) Why constructor of the base class calls first then the constructor of the derived class? Explain with an example. 5

5. a) Define Operator Overloading. Explain the general form of Operator Overloading. 5
   b) Write a C++ program for Unary Operator Overloading. 5
   c) Briefly describe the following terms: i) Dynamic Constructor ii) Destructor 4

6. a) What is an exception? Briefly describe different types of exceptions. 4
   b) Explain the three keywords that are needed for the exception-handling mechanism. 5
   c) Write a C++ program to create a function template with multiple parameters 5

7. a) What is the order of calling the destructor function in a multilevel inheritance? 3

b) Imagine a publishing company that markets both book and audiocassette versions of its works. 8

i. Create a class publication that stores the title (a string) and price (type float) of the publication. From this class:

ii. Derive two classes: book, which adds a page count (type int); and tape, which adds a playing time in minutes (type float).

iii. Each of these three classes should have a getdata( ) function to get its data from the user at the keyboard and a putdata( ) function to display its data.

iv. Write a main( ) program to test the book and tape classes by creating instance of them, asking the user to fill in data with getdata( ) and then displaying data with putdata( ).

c) What will be the order of execution of constructors in the following class declarations? 3

i. class D: public class B1, public B2

ii. class D: public virtual class V, private class B1, public class B2

iii. class D: public B1, public B2, public virtual V.

8. a) What is EOF? How can we detect EOF in a file? 2

b) What do you understand from the following code lines? 3

```
infile.seekp(n,ios::beg)
infile.seekp(n,ios::cur)
infile.seekp(-n,ios::end)
```

c) Write a C++ program to write the following message into the file named 'data.txt'. 9

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i. Read the data from the 'data.txt' file in reverse order.

ii. Count the number of lines in the 'data.txt' file.

iii. Count the total number of characters in the 'data.txt' file.

Mawlana Bhashani Science and Technology University

Information and Communication Technology Department

1st Year 2nd Semester B.Sc. (Engg.) Final Examination-2021

Course title: Matrices and Co-ordinate Geometry **Course ID: ICT-1209**

Marks: 70 **Times: 3 hours**

1. (a) Define transpose of a matrix, symmetric, and skew-symmetric matrix with examples. 3

(b) Prove that every square matrix can be uniquely expressed as the sum of a symmetric and a skew-symmetric matrices. 6

(c) Find the symmetric and skew-symmetric parts of the matrix: 5

$$A = \begin{bmatrix} 1 & 2 & 4 \\ 6 & 8 & 1 \\ 3 & 5 & 7 \end{bmatrix}$$

2. (a) Define orthogonal matrix. Show that the following matrix is orthogonal. 5

$$A = \begin{bmatrix} cos\theta & -sin\theta & 0 \\ sin\theta & cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(b) Define idempotent matrix with an example. If A and B are idempotent matrices, then show that $(A+B)$ will be idempotent, if and only if $AB = BA = 0$. 5

(c) Define Hermitian and skew-Hermitian matrices. Show that the following matrix is Hermitian. 4

$$A = \begin{bmatrix} 1 & 1-i & 2 \\ 1+i & 3 & i \\ 2 & -i & 0 \end{bmatrix}$$

3. (a) Define singular matrix, non-singular matrix, and inverse of a matrix. 7

i. Find the inverse of the following matrix

ii. Deduce that $AA^{-1} = A^{-1}A = I$, where I is the identity matrix.

$$A = \begin{bmatrix} 2 & -1 & -1 \\ 1 & -2 & 1 \\ 1 & -1 & 2 \end{bmatrix}$$

(b) Solve the following system of linear equations using matrices: 7

$$2x - y - z = 6$$
$$x + 3y + 2z = 1$$
$$3x - y - 5z = 1$$

4. (a) Define characteristic equation and characteristic roots of a matrix. 2

(b) State Cayley-Hamilton Theorem. 5

i. Verify Cayley-Hamilton theorem for the following matrix

ii. Find A^{-2}

$$A = \begin{bmatrix} 1 & 2 \\ -1 & 1 \end{bmatrix}$$

(c) Find the eigenvalues and eigenvectors of the matrix $A = \begin{bmatrix} 1 & 4 \\ 9 & 1 \end{bmatrix}$. Also find the matrix P that diagonalizes A and determine $P^{-1}AP$. 7

5. (a) Prove the following condition that the gradient of one of the lines $ax^2 + 2hxy + by^2 = 0$ be the same of the gradient of the other is $ab(a+b) = 6abh - 8h^3$. 5

(b) Show that the lines joining the origin to the points of intersections of the line $y = mx + c$ and the curve $y^2 = 4ax$ will be coincident, if $c = a/m$. 4

(c) Show that the equation $x^2 + 6xy + 9y^2 + 4x + 12y - 5 = 0$ represents a pair of parallel straight lines and the distance between them is $3\sqrt{10}/5$. 5

6. (a) Transform the equation $17x^2 + 18xy - 7y^2 - 16x - 32y - 18 = 0$ to one in which there is no terms involving x, y and xy, both sets of axes being rectangular. 7

(b) Prove that the length of the common chord of the two circles whose equations are $(x-a)^2 + (y-b)^2 = c^2$ and $(x-b)^2 + (y-a)^2 = c^2$ is $\sqrt{(4c^2 - 2(a-b)^2)}$, where $a \neq b$. 7

7. (a) Define direction cosines and direction ratios of a line. If (l_1, m_1, n_1) and (l_2, m_2, n_2) be the direction cosines of any two lines, then find the angle between them. 4

(b) Find the equation of the plane which passes through the points $(2, 2, 1)$ and $(9, 3, 6)$ perpendicular and is perpendicular to the plane $2x + 6y + 6z + 9 = 0$. 4

(c) Prove that the equation $2x^2 - 6y^2 - 12z^2 + 8yz + 2zx + xy = 0$ represents a pair of planes and also find the angle between them. 6

8. (a) Find in symmetrical form the equation of a line $x + y + z + 1 = 0 = 4x + y - 2z + 2$ and find its direction ratio's. 7

(b) Prove that the following lines : 7

$(x-1)/2 = (y-2)/3 = (z-3)/4$ and $(x-2)/3 = (y-3)/4 = (z-4)/5$

are coplanar. Also find the equation of the plane in which they lie.

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Mawlana Bhashani Science and Technology University
BSc ICT 1st Year 2nd Semester (Engg.) Final Examination 2022

Course Title: Discrete mathematics — Course Code: ICT-1207

Time: 3 hours — Total marks: 70

Answer 5 (Five) questions

1. a) What is a complete ***m-ary*** tree? 2
   b) How many non-isomorphic unrooted trees are there with three vertices? 6
   c) Draw ***3-*** and ***4-ary*** trees of height of 2. 6

2. a) Illustrate Hoffman code with an example. 3
   b) Suppose there are seven coins, all with the same weight and a counterfeit coin that weighs less than the others. How many weighing are necessary which of the eight coins is the counterfeit one? 3
   c) In-order traversal yielded ***{j, e, n, k, o, p, b, f, a, c, l, g, m, d, h, i}***. What will be the post-order traversal? 8

3. a) Congruence ***14 ≡ 8 (mod 6)*** holds. What would happen if both sides are divided by ***2***? 4
   b) What are the solutions of the linear congruence ***3x ≡ 4 (mod 7)?*** 6
   c) Is ***084 930 149X*** a valid ***ISBN-10***? 4

4. a) Decrypt the message ***DSWO PYB PEX*** using shift cypher with shift ***k = 10***. 5
   b) Find four numbers congruent to ***5 modulo 7***. 5
   c) Prove that ***ab = gcd(a,b) . lcm(a,b).*** 4

5. a) Use mathematical induction to prove that $n^3 - n$ is divisible by ***3,*** when ***n*** is a positive integer. 5
   b) What is the co-efficient of $x^{12}y^{13}$ in the expression of $(x+y)^{25}$? 5
   (c) Let ***n*** be a nonnegative integer. Then prove that $\sum_{k=0}^{n}\binom{n}{k} = 2^n$. 4

6. a) Prove that ***C(n,r) = C(n,n-r).*** 4
   b) How many bit strings of ***n*** contain exactly ***r 1s***? 5
   c) Assume that, in a group of six people, each pair of individual consists of two friends and two enemies. Show that there are either three mutual friends or three mutual enemies in the group. 5

7. a) Find the Fibonacci numbers f_2, f_3, f_4, f_5, and f_6. Then write a program to calculate the Fibonacci numbers. 4
   b) Prove or disprove that $\lceil x + y \rceil = \lceil x \rceil + \lceil y \rceil$ for all real numbers x and y. 4
   c) Find the values- 6
      i. $\sum_{i=1}^{3}\sum_{j=1}^{4} ij$
      ii. $\sum_{k=50}^{100} k^2$

8. a) For A, B, C be sets, show: 4

$$\overline{A \cup (B \cap C)} = (\overline{C} \cup \overline{B}) \cap \overline{A}$$

   b) The bit strings for the sets ***{1, 2, 3, 5, 4}*** and ***{1, 3, 5, 7, 9}*** are ***11110 0000*** and ***10 1010 1010***, respectively. Use bit strings to find the union and intersection of these sets. 4
   c) Use quantifiers to express the statement that ***"There does not exist a woman who has taken a flight on every airline in the world."*** 6

Mawlana Bhashani Science and Technology University

Information and Communication Technology Department

1st Year 2nd Semester B.Sc. (Engg.) Final Examination-2021

Course title: Electronic Device and Circuit Theory **Course ID: ICT-1201**

Marks: 70 **Times: 3 hours**

1. (a) What is valance shell? Discuss about how depletion region is created in a p-n junction. 4
   (b) A p-n junction diode has parameters $I_s = 10^{10}$ A and n = 2. Find the diode current at room temperature if the diode voltage is 0.7 V. 4
   (c) Draw the simplified equivalent circuit for diode and hence show ideal characteristics. 2
   (d) If the diode current defined as $I_D = I_s e^{\frac{V_D}{nV_T}}$ for the forward bias condition, show that the dynamic resistance can be represented by $r_d = \frac{nV_T}{I_D}$. 4

2. (a) Draw the block diagram of a regulated power supply and write the function of each block. 4
   (b) Show that the dc voltage of a half wave rectifier is $V_{dc} = 0.318V_m$, where each symbol has their usual meanings. Also, explain how a real diode affects the dc voltages of it? 6
   (c) What is the purpose of rectification? Draw a center tapped transformer full wave rectifier and explain its operation. 4

3. (a) What is PRV of a diode? How it can be determined? 4
   (b) Determine the output waveform for the network shown in Fig. 3 (b) and calculate the output dc level and the required PIV of each diode. 6

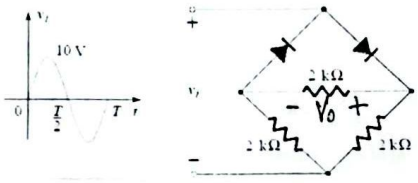


Fig. 3(b)

   (c) What are the advantages of full wave rectifier over half wave rectifier? 4

4. (a) Explain positive and negative clipper circuits with proper examples. 4
   (b) Sketch v_o for the following network: 6

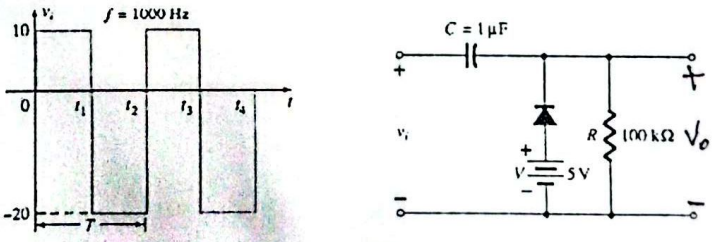


Fig. 4(b)

   (c) Circuit as below 4
   a. Sketch the output v_o and determine dc level of the output voltage for ideal diode
   b. What is the practical diode?
   c. The V_m is increase to 200V

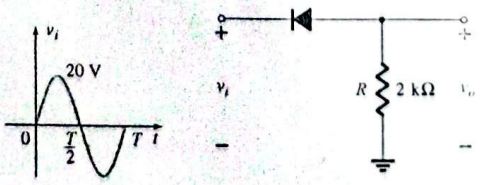


Fig. 4(c)

5. (a) What is transistor? Draw the symbol *npn* and *pnp* transistor. 3

(b) What do you mean by active, saturation and cutoff mode. Why active mode is suitable for amplification- justify? 4

(c) Briefly describe the common-base transistor amplifying action. 7

6. (a) What is the major difference between a bipolar and a unipolar device? 4

(b) What is thermal runaway? What is its significance? 4

(c) Determine the quiescent levels of I_{CQ} and V_{CEQ} for the network shown in Fig. 6(c). 6

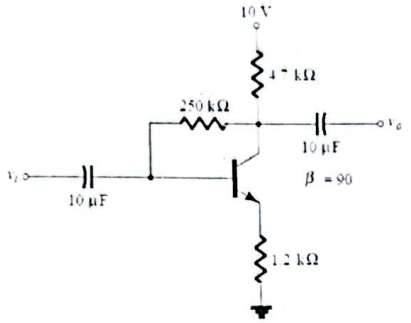


Fig. 6(c)

7. (a) BJT is current controlled device whereas FET is voltage controlled device"-Justify. 4

(b) With neat diagram explain the construction and characteristic of *p*-channel FET. 6

(c) Determine the following for network shown in Fig. 7(c). 4

(i) I_{DQ} and V_{GSQ}.

(ii) V_D.

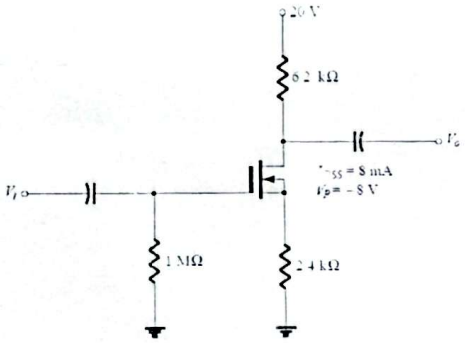


Fig. 7(c)

8. (a) List some applications of Zener diode. 3

(b) Define Zener breakdown voltage. Zener diodes are most frequently used in voltage regulator networks – Justify the statement with example. 5

(c) For the following network, 6

i. determine the range of R_L and I_L that will result in V_{RL} being maintained at 10 V.

ii. Determine the maximum wattage rating of the diode.

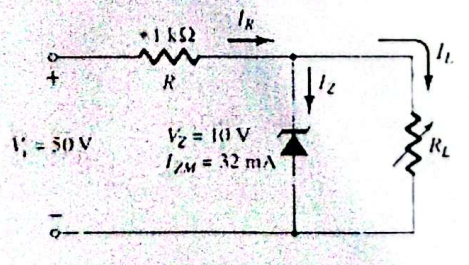


Fig. 8(c)

Mawlana Bhashani Science and Technology University

Department of Information and Communication Technology

1st Year 2nd Semester B.Sc. (Engg.) Final Examination 2021

Course Title: Data Structure
Marks: 70

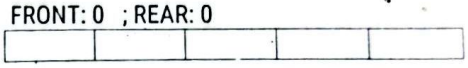
Course Code: ICT-1205
Time: 3 Hours

Answer any FIVE questions. Maintain sequences while answering.

1. a) Define primitive and nonprimitive data structure. Briefly explain major or the common operations that can be performed on the data structures. 5
   b) Define Splay Tree. What are the properties of Splay Tree? 3
   c) What is Sparse Matrix? What are the applications of Sparse Matrix? 2
   d) Explain the concept of overflow and underflow with suitable example 4

2. a) A queue may be maintained by a circular array QUEUE with N = 5 memory locations. Observe that the queue always occupies consecutive locations except when it occupies locations at the beginning and at the end of the array. If the queue is viewed as a circular array, this means that is still occupies consecutive locations. 5
   Describe the queue as the following operation take place:
   i. Initially empty:
   ii. A, B and then C inserted:
   iii. A deleted:
   iv. D and then E inserted:
   v. B and C deleted:
   vi. F inserted:
   vii. D deleted:
   viii. G and then H inserted:

   FRONT: 0 ; REAR: 0

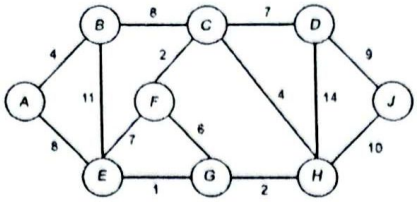
   

   Demonstrate each and every step during these operations and update the value of FRONT and REAR.
   b) The following list of names is assigned (inorder) to a linear array INFO: Mary, June, Barbara, Paula Diana, Andrey, Karen, Nancy, Ruth, Eileen, Sandra, Helen. 7
   That is INFO[1] = Mary, INFO [2] = June... INFO [12] = Helen.
   i. Assign values to array LINK and a variable START so that INFO, LINK and START from an alphabetic listing of names, Show the updated status f names and variables after following operations
   ii. Delete Diana
   iii. Add Winey
   c) Is it possible to apply linear search or binary search to find out the data in a link list? Explain it. 2

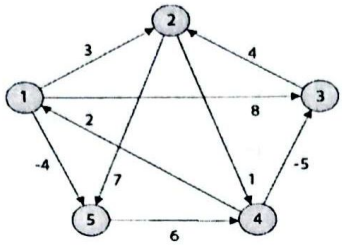
3. a) Apply merge sort over the following elements of an array and show what will happen in every pass. 5
   Array [15]: [3, 44, 38, 5, 47, 15, 36, 26, 27, 2, 46, 4, 19, 50, 48]
   b) Consider the sorted array A [15] = [1, 2, 4, 7, 9, 15, 21, 23, 34, 42, 48, 59, 60, 65, 70]. Now find out the number x = 65 from the sorted array utilizing binary search approach. Also compare the results with linear search. 5
   c) Briefly describe the polish notation. Convert the following infix notation to respective prefix and post arithmetic notation 4
   i. A+B*C/(E-F)
   ii. (A + B) * (C + D)

4. a) Write an algorithm for insertion sort 12, 45, 56, 78, 90, 32, 66, 55, 11, 44 elements of an array and show what will happen in every pass. 6
   b) Compute the complexity of merge sort algorithm for different scenario. 4
   c) Is every AVL tree can be a Red-Black tree? Explain it. 2
   d) Two well-known minimum connector algorithms are Kruskal's and Prim's algorithm. What are the key differences between them? 2

5. a) Construct the minimum spanning tree (MST) for the following graph using Kruskal's Algorithm. 6



b) Consider the following directed weighted graph. Using Floyd Warshall Algorithm, find the shortest path distance between every pair of vertices. 8



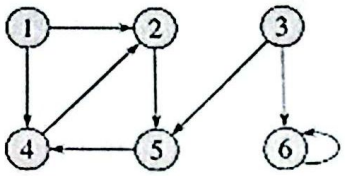
6. a) A file contains the following message with the frequencies as shown below. If Huffman Coding is used for data compression, determine: 6

Message: MMNNSPPOSSNNSMMSOP

i. Huffman Code for each character
ii. Length of Huffman encoded message (in bits)

b) Write an algorithm to insert an item into the given position in linear array. 4

c) Construct an adjacent matrix and adjacent list for the following directed graph. 4



7. a) What is an application of the longest common subsequence? Find out the longest increasing subsequence (LIS) for the following sequence. 6

Sequence: 13, 1, 3, 4, 8, 19, 17, 8, 0, 20, 14

[N.B.: To extract the subsequence, the array that stores the integer data is traversed. There will be more than one increasing subsequence, but the sequence with the maximum increasing elements is the one.]

b) What do you mean by Hashing? Mention some real-life applications of Hashing. 3

c) Use division method and open addressing to store the given values $D = 3, 2, 9, 6, 11, 13, 7, 12$. You should follow the function $h(k) = 2k + 3$ and $m = 3$. 5

8. a) What do you mean by game tree and decision tree? List some real life the applications of those trees. 4

b) Construct a Binary Search Tree (BST) for the following chronological succession of numbers 6
50, 70, 65, 60, 55, 20, 80, 90, 75, 10, 40, 100

c) How you can differentiate Depth First Search (DFS) from Breadth First Search (BFS) ? 2

d) Sketch and explain a complete binary tree and a full binary tree. 2