L-2/T-1/CSE **Date : 17/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 263** (Electronic Devices and Circuits)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Symbols have their usual meanings.

1. (a) Find the values of I and V in the circuit of Fig. for Q. No. 1(a). Use the 0.7 V drop diode model. **($10\frac{2}{3}$)**

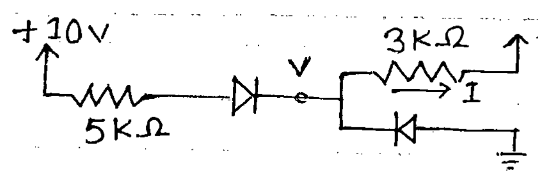

Fig. for Q. No. 1(a)

(b) The small-signal model of diode is said to be valid for voltage variations of about 10 mV. To what percentage current change does this correspond for n = 1 (consider both positive and negative signals)? What is the maximum allowable voltage signal (positive or negative) if the current change is limited to 10%? **(16)**

(c) A peak rectifier circuit is operated with a 1 KΩ load and a diode that can be modeled to have a 0.7 V drop at any current. It is fed by a 50 Hz sinusoid and the capacitor is chosen to provide a peak-to-peak ripple voltage of 10% of the peak output voltage. **(20)**

(i) What is the value of the capacitor?

(ii) What fraction of the cycle does the diode conduct?

(iii) What is the average diode current?

(iv) What is the peak diode current?

Consider, the load current (I_L) is 15 mA.

2. (a) Assuming that the diodes are ideal, find the output voltage V_0 for the circuit given in Fig. for Q. No. 2(a). Draw the wave shape clearly. **(20)**

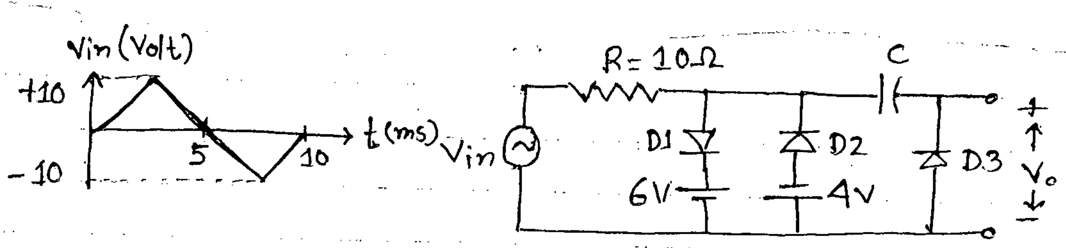

Fig. for Q. No. 2(a).

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Contd... Q. No. 2

(b) Calculate the regulated load voltage (V_L) and the current (I_Z) flowing through the zener diode in the following voltage regulator circuit shown in Fig. for Q. No. 2(b). **(16)**

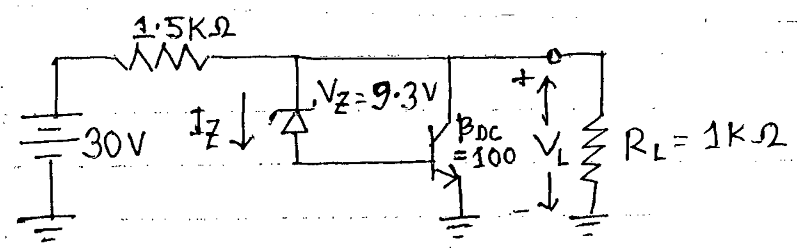

Fig. for Q. No. 2(b)

(c) The input output characteristics of the following circuit is given in Fig. for Q. No. 2(c). What will happen (i) if V_{cc} is increased, (ii) if R_c is increased? — Explain with the characteristic curve. **(10⅔)**

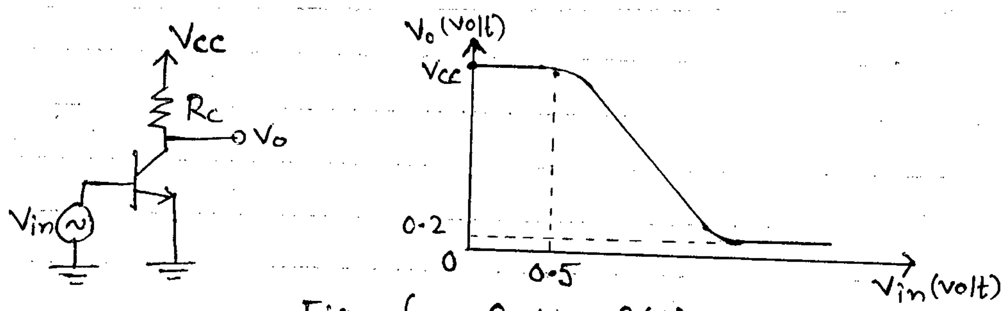

Fig. for Q. No. 2(c)

3. (a) Find the expression for the emitter current in the circuit of Fig. for Q. No. 3(a). What are the conditions that should be satisfied? How is the feed back operation of the R_E performed? **(16)**

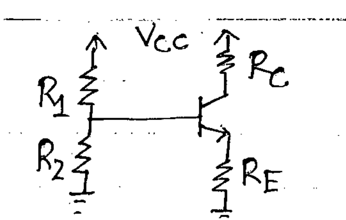

Fig. for Q. No. 3(a)

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Contd... Q. No. 3

(b) In Fig. for Q. No. 3(a), if $R_1 = 40\ K\Omega$, $R_2 = 10\ K\Omega$, $R_c = 1.5\ K\Omega$, $R_E = 1\ K\Omega$, $V_{cc} = 12\ V$ and $\beta = 1000$, calculate the biasing point. How can the values of R_1 and R_2 be changed for a good biasing design? **(10⅔)**

(c) For the circuit shown in Fig. for Q. No. 3(c), determine R_{in}, R_{out}, V_0/V_i and i_0/i_i. The BJT is biased with I = 5 mA and has $\beta = 100$ and $V_A = 100$ V. **(20)**

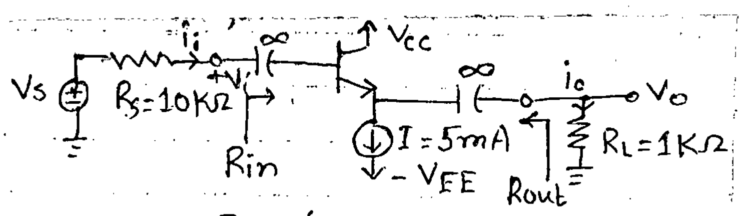

Fig. for Q. No. 3(c)

4. (a) The NMOS and PMOS transistors in the circuit shown in Fig. for Q. No. 4(a) have $K'_n\left(\frac{W_n}{L_n}\right) = K'_p\left(\frac{W_p}{L_p}\right) = 1\ mA/V^2$ and $V_{tn} = -V_{tp} = 1V$. Assume $\lambda = 0$. Find i_{DN}, i_{DP} and v_0 for V_i = +2.5 V, –2.5 V. **(20)**

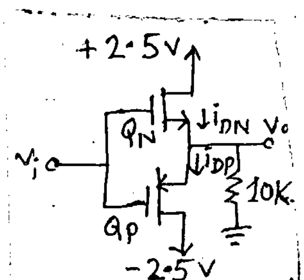

Fig. for Q. No. 4(a)

(b) The NMOS transistors in the circuit in Fig. for Q. No. 4(b) have $V_t = 1$ V, $\mu_n C_{ox} = 120\ \mu A/V^2$, $L_1 = L_2 = 1\ \mu m$. Find W_1, W_2 and R. Here, W_1 and W_2 are the gate widths of Q_1 and Q_2 transistors, respectively. **(16)**

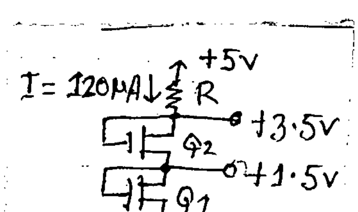

Fig. for Q. No. 4(b)

(c) How the MOSFET Transconductance (g_m) can be varied with the design parameters $\frac{W}{L}$ ratio and overdrive voltage, V_{ov}? — Explain. **(10⅔)**

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is the value of output voltage (V_0) for the circuit shown in Figure for Q. No. 5(a). **(16⅔)**

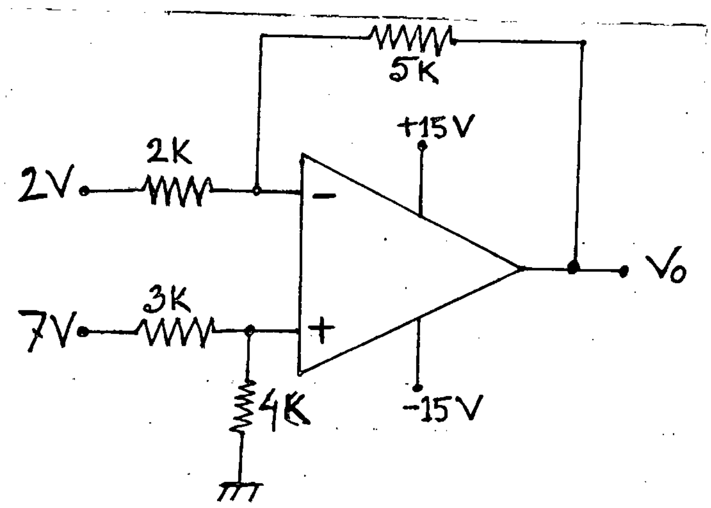

Figure for Q. No. 5(a)

(b) Design a Schmitt trigger that triggers from +16 V to –16 V at an input voltage of 12 V and triggers from –16 V to +16 V at an input voltage of 8 V. Specify all the values of resistors used and reference DC voltage. **(15)**

(c) Design a circuit using Op-Amps that gives output waveform shown in Fig. for Q. No. 5(c) from a 1 V DC input. Specify all the values of Resistors and Capacitor used. Use +15 V and –15 V for DC biasing. **(15)**

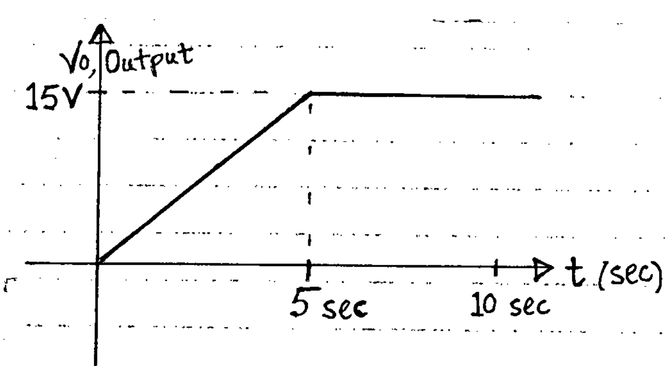

Figure for Q. No. 5(c)

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6. (a) Design a circuit using Op-Amps that can solve the following differential equation: **(20)**

$$3\cdot\frac{d^2x(t)}{dt^2}+4x(t)=0$$

Also point out the node that represents the solution $x(t)$. Specify all the values of resistors and capacitors used.

(b) Suppose, you have two input voltages x_1 and x_2. Now design a circuit using Op-Amps that gives output $V_0 = 10x_1x_2$. The diodes available for the design maintain the characteristic equation $I_D = I_s\, e^{\left(\frac{V_D}{nV_T}\right)}$, where $I_s = 10^{-6}$ A. Specify all the values of resistors used. **(26⅔)**

7. (a) Write the equation of magnitude of gain of a –20 dB/decade low pass filter. Why is it called –20 dB/decade filter? Can it also be called –6 dB/octave filter? **(3+12+5)**

(b) Design a notch filter that eliminates any signal between 8 kHz and 12 kHz using op-amps. Specify all the values of resistors and capacitors used. **(20)**

(c) Write down the Barkhausen stability criterion for an oscillation in linear electronic circuit to sustain. **(6⅔)**

8. (a) Design a Wien Bridge Oscillator with an oscillation frequency of 1 kHz. What is the gain of the feedback network of your design? Specify all the values of resistors and capacitors used. **(17+3)**

(b) Derive expression of Desensitivity. Explain positive and negative feedback from desensitivity. **(10+5)**

(c) Draw the circuit diagram of controlled full wave rectifier using SCR. Draw the waveforms of sinusoidal input, gate pulses and rectified output. **(11⅔)**

L-2/T-1/CSE **Date : 23/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 201** (Object Oriented Programming Language)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Write down some syntactic differences between C and C++ programming? **(10)**

(b) What is meant by the term "anonymous union"? Write down the restrictions that are applicable for anonymous union. **(10)**

(c) Write down the problem associated with the following class declaration- **(5+5+5)**

```
class myclass{
    int *p;
public:
    myclass(int n){
        p = (int *) malloc(sizeof(int));
        if (!p){ cout << "Allocation problem\n"; exit(1);}
        *p = n;
    ~myclass(){ free(p);}
}
```

Write down a copy-constructor to solve the problem and explain how it works.

2. (a) What is meant by the term "independent reference" in C++? How does an independent reference allow a function call to be written to left side of an assignment operator? **(4+4)**

(b) Two overloaded functions are declared as follows- **(7)**

```
void space(char ch){
    ----------------------------
}
void space(char ch, int count){
    ----------------------------
}.
```

Write down a main() function that will find the addresses where the above two functions are stored and make function calls using those addresses.

(c) Let $x + iy$ is a complex number where x is the real part and y is the imaginary part. Declare a class named "complex" that has members and/or friends to fulfill the following requirements- **(20)**

Contd P/2

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Contd... Q. No. 2(c)

Requirement	Sample code	Explanation
Creating instance	Complex ob(12.0, 5.0);	The first and the second arguments are the real and the imaginary parts respectively.
Addition of two complex number objects	ob1 = ob2 + ob3	The real and the imaginary parts will be added separately.
Incrementing complex number	ob++; ++ob;	Incrementing both the real and the imaginary parts.
Adding a real number to an object	ob2 = ob1 + 100.0; ob2 = 100.0 + ob1;	The real number will be added to the real part of the object and the imaginary part will remain unchanged.

3. (a) What is virtual function? Why is a virtual function used in C++ programming? **(7)**

   (b) Differentiate between early binding and late binding with appropriate examples. **(8)**

   (c) Consider the following class declaration- **(12)**

```
class inventory {
    char item[40];
    int onhand;
    double cost;
public:
    inventory (char *i, int o, double c ) {
        strcpy(item, i);
        onhand = o;
        cost = c;
    }
};
```

   Write down the inserter and the extractor methods for the class and modify the class as necessary to work with the inserter and the extractor.

   (d) Write down a manipulator named "setup" that will generate the following output against the statement of "cout<<setup<<123.45678;" **(8)**

   123.456%%%

4. (a) Consider that the mapping <stdId, object> is used in an object oriented programming to store the records of the students, where stdId (i.e., student identification number) is unique for each student. Write a C++ program that will scan stdId from keyboard and print the name of student from its associated object using map. Make necessary assumptions. **(10)**

   (b) Write down a generic class named "queue" where all types of data such as integer, character, string, double and object of any kind can be stored and queued. **(15)**

   (c) Explain different types of casting used in C++ with examples. **(10)**

Contd P/3

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is the different between following two declarations in Java? **(10)**

   (i) int c [], x

   (ii) int [], c, x

   Write 2 (two) different ways of creating the following array in Java.

0			
0	0		
0	0	0	
0	0	0	0
0	0	0	
0	0		
0			

   (b) Consider the following main method: **(10)**

```
public class TestMain {
    public static void main (String [] args) {
        int a = testf ("sum", 1, 2, 4, 5, 6);    // a = 18
        int b = testf ("sum", 1, 3, 6);          // b = 10
        int c = testf ("mult", 1, 2, 4, 5, 6);   // c = 240
        int d = testf ("mult", 1, 3, 6);         // d = 18
    }
}
```

   Write the Java function **testf** in the appropriate place. You can write only one **testf** function.

   (c) Write 2 (two) different ways to convert an int value to a String. Write a Java program that takes N integers from command line and prints the maximum and the minimum of them. **(10)**

   (d) Write a Java class named **MyClass** with a variable named **objectCount** that keeps track the number of objects created for **MyClass**. When the total number of objects is greater than 100, reinitialize **object Count** to 0. **(5)**

Contd P/4

CSE 201

6. (a) Consider your own **StrignTokenizer** class - **MyStringTokenizer** with the following methods: **(10)**

MyStringTokenizer (String str, String delimiter) – the only constructor that takes the main String and the delimiter for tokenize

int countTokens () – returns total number of tokens

boolean hasMoreTakens () – returns false if no more token left, true otherwise

String nextToken () – returns the next token

Write complete Java code for your **MyStringTokenizer** class. You can add necessary instance variables. You can't use the original **StringTokenizer** class. You can only use the split method of **String** class which works as follows:

```
String s = "what is your name?";
String [] t = s.split(" ");
t [0] = what, t [1] = is, t [2] = your, t [3] = name
```

(b) Consider the following Java code: **(10)**

```
interface interface1 {
    default void f1() {
    }
    void f2();
}
interface interface2 {
    void f3();
    void f4();
}
abstract class class1 implements interface1 {
    abstract void f5();
    final void f6() {
    }
}
class myclass extends class1 implements interface2 {
    // your code
}
```

Write minimum code for **myclass** for successful compilation. You can't define myclass as abstract.

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Contd... Q. No. 6

(c) Suppose there are 7 methods defined as following **(10)**

void f1(), void f2(), void f3(), void f4(), void f5(), void f6(), and void f7()

There are also 4 interfaces named as: interface i1, i2, i3 and i4

There is also a class named as MyClass that needs to be forced to implement all the 7 methods. But there are some constraints

1. Each interface can define at most 2 methods.
2. The class **MyClass** can only implement 1 interface.

Write Java code for **MyClass** to achieve this scenario.

(d) What are the 3 (three) uses of Java **final** keyword? Consider a public class **Balance** declared under package **MyPackage**. Write full commands to compile and run the **Balance** class from command line. **(5)**

7. (a) Consider a **MyStack** class implemented with array and with the following functions: **(10)**

void push (Object o) – this method pushes an Object o into the stack

Object pop () – this method pops an Object from the stack

Object top () – this method returns the Object in the top of the stack without modifying the stack

boolean isEmpty () – this method returns true if the stack is empty, otherwise false

MyStack class has the following instance variables:

final int CAPACITY = 100 – capacity of the stack

Object [] s – the array to hold the stack

int top – the top of the stack

Here are the restrictions:

1. In MyStack, pop () and top () cannot be performed if the stack is empty. In that case it will trigger **StackEmptyException** with the message 'Stack is Empty'.
2. In MyStack, push () cannot be performed if the stack is full. In that case it will trigger **StackFullException** with the message 'Stack is full'.

Write Java code for the custom exceptions mentioned above. You also need to write the MyStack class to trigger these exceptions when needed.

(b) Mr. Chandler and Ms. Phoebe worked in the same place. Their work is to put and get product in a shared inventory array of size 3. Ms. Phoebe puts a single product in the inventory and Mr. Chandler gets a single product from the inventory at a time. Ms. Phoebe cannot put a product to the inventory if the inventory array is full with 4 products. Mr. Chandler cannot get a product from a inventory if the inventory array contains no product. Ms. Phoebe can put a product to the inventory if any one of the place of the inventory array is empty. Mr. Chandler can get a product from the inventory

Contd P/6

CSE 201

Contd... Q. No. 7(b)

if any one of the place of the inventory array is full with a product. Write a java code to solve the above mentioned problem using the concepts of inter thread communication. You can use **wait/notifyAll** or **ArrayBlockingQueue**. **(10)**

(c) With Java threads, it is very easy to parallelize computations. Suppose you are in a job interview and the interviewer asked you to write Java code to find out summation of 1 to 1000. You can't use any simple equation, you can only use loops. But you are asked to divide the work equally among 4 different threads. Write complete Java code to compute the summation of 1 to 1000 by dividing the work equally among 4 different threads. The main thread will wait for the 4 threads to finish and will only print the final summation. **(10)**

(d) What are the different ways of creating threads in java? Which one is better and why? **(5)**

8. (a) Write five differences between **Hashtable** and **HashMap**. **(10)**

Consider the following information of different account holders in a bank.

Name	Balance
John Doe	3434.34
Tom Smith	123.22
Jane Baker	1378.00
Tod Hall	99.22
Ralph Smith	19.08

Write Java code for the following:

(i) Create a **Hashtable** to store the above information
(ii) Store the above five information to the **Hashtable**
(iii) Increase John Doe's balance by 100

(b) Consider the following class: **(10)**

```
class Product {
  private String name;
  private double price;
  Product (String name, double price) {
    this.name = name;
    this.price = price;
  }
  public String getName() {
    return this.name;
  }
  public double getPrice() {
    return this.price;
  }
}
```

Contd P/7

CSE 201

Contd... Q. No. 8(b)

Write java code for the following:

(i) Define an **ArrayList** named **myProducts** that can store a list of **Prouct**.

(ii) Generate 5 **Product** with 'A' to 'E' and random prices and add them to **myProducts**.

The following code generates random integers between 0 to 500

```
Random r = new Random(); r.nextInt(500);
```

(iii) Add a new **Product** with name 'F' and price 1000 at index 1 of **myProducts**

(iv) Sort **myProducts** based on Product's price in ascending order. You can't use your own sorting techniques. You can change the **Product** class if necessary.

(c) Write Java code to copy a file named **src.txt** to a file named **dst.txt** line by line using **BufferedReader** and **BufferedWriter**. **(10)**

Consider the following class:

```
Class MyClass implements Serializable{
        String name;
}
```

What are the Java classes and methods that can read/write objects of **MyClass** to input/output stream?

(d) Consider the following football clubs, their point and position in the English Premier League: **(5)**

Club	Point	Position
ManUnited	90	1
Chelsea	80	2
Arsenal	75	4
Liverpool	30	19
ManCity	25	20

Write Java code for the following:

(i) Declare a single Enumeration named **EPL** for the above clubs

(ii) Find out the difference between league position of **ManUnited** and **Liverpool** (you can't simply write 18).

L-2/T-1/CSE **Date : 27/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 203** (Data Structures)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Prove that any comparison sort algorithm requires $\Omega(n \log n)$ comparisons in the worst case. **(10)**

   (b) Write a linear-time Bucket Sort algorithm. Prove that time complexity of the algorithm is linear. **(10)**

   (c) Write the Quick Sort algorithm. Analyze the best-case and worst-case time complexity of the algorithm. **(15)**

2. (a) Write an algorithm for building a heap. Show that an n-element heap can be built using $O(n)$ time. **(10)**

   (b) What are the main operations of a priority queue? How could we implement these operations using a heap? **(10)**

   (c) Compare linked lists and skip lists. Show that the expected space used by a skip list with n entries is $O(n)$. **(15)**

   Draw the skip-list for the following table that shows the keys and consecutive numbers of the heads found in toss while inserting the keys in the skip-list.

Key	15	40	35	28	21	65	84	79	50
No. of consecutive heads	1	4	1	0	3	2	2	3	1

3. (a) Explain, with examples, the single rotation and double rotation operations on AVL trees. **(10)**

   (b) What is a Multiway Search tree? How do we search a key in a Multiway Search tree? **(10)**

   (c) What makes a good hash function? Explain the three commonly used techniques to compute the probe sequences required for open addressing in a hash table. **(15)**

4. (a) Draw the binary search tree that results after successively inserting the keys 15, 8, 24, 12, 40, 18, 20, 23 into an initially empty binary search tree. Then, by using necessary rotations, redraw the binary search tree so that it becomes an AVL tree. **(10)**

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Contd... Q. No. 4

(b) Write the properties of a red-black tree. Show that the height of a red-black tree T storing n items is $O(\log n)$. **(10)**

(c) Explain, with examples, the four cases that may arise for deleting a node from a red-black tree. **(15)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Suppose that you are given the following doubly linked list implementation that uses head and tail pointers: **(15)**

```
struct listNode
{
        int item ; //will store data
        struct listNode *next ; //will keep address of next node
        struct listNode *prev ; //will keep address of previous node
} ;
struct listNode * head ; //points to the first node of the list
struct listNode * tail ; //points to the last node of the list
```

Implement the function *"void delete(int N)"* that deletes all Mth nodes of the list such that $M \bmod N = 0$ where $N > 0$. For example if $N = 3$, the function should delete 3rd node, 6th node, 9th node, and so on. The node pointed by *head* is the 1st node. Your implementation should be as efficient as possible.

(b) Compare the worst case run times of *ArrayList* and *LinkedList* (doubly with heat and tail pointers) for the following operations: **(4×3=12)**

(i) Insert an item at the Nth position of the list (need to preserve order of items)
(ii) Remove the first item of the list (need to preserve order of item)
(iii) Remove the Nth item of the list (need to preserve order of item)
(iv) Get (without removing) the Nth item of the list

(c) Give two advantages and disadvantages of using array based lists over linked lists. **(8)**

6. (a) Suppose we create a binary search tree by inserting the following values in the given order: 50, 10, 13, 45, 55, 110, 5, 31, 64, and 47. Answer the following questions: **(5+4+4+6=19)**

(i) Draw the binary search tree.
(ii) Show the output values if we visit the tree using pre-order traversal technique.
(iii) Show the output values if we visit the tree using post-order traversal technique.
(iv) Show the resulting trees after we delete 47, 110, and 50. (Each deletion is applied on the original tree.)

Contd P/3

CSE 203

Contd... Q. No. 6

(b) Suppose that we are given the following definition of a rooted binary tree (**not binary search tree**): **(12)**

```
struct treeNode
{
        int item ; //stores the value
        struct treeNode * left ; //points to left child
        struct treeNode * right ; //points to right child
} ;
struct treeNode * root ; //global variable to store tree root node
```

Implement the following function *clone* (**must be recursive**) that makes a copy of a binary tree (keeping the original tree intact). The function will be called using the original root pointer as input argument. The function should return the root node of the new copy. For example calling $x = clone(root)$ will return the new root (of the tree copy) into variable x.

```
struct treeNode * clone(struct treeNode * node);
```

(c) Give two reasons why we should use restrictive data structures (e.g., Stack and Queue) instead of general purpose data structures. (e.g., List) **(4)**

7. (a) Suppose you are given the following definition of a singly linked list having head and tail pointers; **(15)**

```
struct listNode
{
        int item ; //will be used to store value
        struct listNode *next ; //will keep address of next node
} ;
struct listNode * head ; //points to first node of the list
struct listNode * tail ; //points to last node of the list
```

Implement a **stack** data structure using the above linked list definition. You need to implement only the following functions: *push, pop,* and *size*. The *size* function returns the current size (number of items) of the stack. You cannot use any other global or static variable in your implementation except *head* and *tail* pointers given above. Your implementations should be as efficient as possible.

(b) Suppose that we double the memory of an array based list every time we see that the memory is full during insertion of a new item. Show that the average time required per insertion to copy the existing items from the old memory to the new memory is constant. **(12)**

CSE 203

Contd... Q. No. 7

(c) Give the idea of a data structure that can be used to implement a general tree where nodes can have more than two children. Re-draw the binary search tree shown in Fig. for Q. 7(c) using your proposed data structure. **(8)**

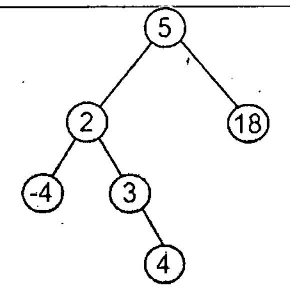


Fig. for Q. 7 (c)

8. (a) Consider the directed graph shown in Fig. for Q. 8(a). Answer the following questions: **(6+6=12)**

   (i) Perform depth first search on the graph starting from vertex *A*. Choose the smallest (in alphabetical order) vertex when there is a choice. Find the discovery time and finishing time of each vertex.

   (ii) Perform breadth first search on the graph starting from vertex *A*. Choose the smallest (in alphabetical order) vertex when there is a choice. Find the distance and parent of each vertex.

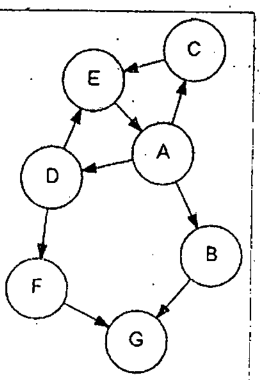


Fig. for Q. 8(a)

(b) For each of the following operations in an undirected graph, find the worst case running times in Big-**O** notation if we use an adjacency matrix; and if we use an adjacency list: **(4+4+6=14)**

   (i) Determine whether a given vertex is connected to no other vertex.

   (ii) Determine whether the graph has a vertex that is connected to no other vertex.

   (iii) Determine whether a given vertex is connected to every other vertex. Give the idea (in two to three sentences) of your algorithm for adjacency list.

(c) Recall that an undirected graph is "connected" if there is a path from any vertex to any other vertex. If an undirected graph is not connected, it has multiple connected components. A "connected component" consists of all the vertices reachable from a given vertex, and the edges incident on those vertices. Suggest an algorithm based on DFS that counts the number of connected components in a graph. Give only the idea or skeleton of the algorithm. **(9)**

L-2/T-1/CSE

Date : 31/01/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 205** (Digital Logic Design)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Find all the prime implicants for the following Boolean function and determine which are essential: **(11)**

$$F(A,B,C,D)=\sum(0,2,3,5,7,8,9,10,11,13,15)$$

(b) Implement the function $F(w,x,y,z)=w'x'+w'x'z+w'yz'$ using two-level forms of logic by **(20)**

(i) NOR gates only

(ii) AND-NOR,

(iii) NAND gates only, and

(iv) OR-NAND.

(c) A decimal number N is represented in a weighted binary code as 0011 0100 1010 1100. Write the decimal digits of N, if the following weights are used for the weighted binary code: 6, 3, 1, 1. **(4)**

2. (a) Show the truth table for the following function: **(8)**

$$F(x,y,z)=(x+y+z)(x+y+z')(x+y'+z)(x'+y+z)$$

(b) Design a full adder with a decoder and basic logic gates. **(12)**

(c) Simplify the following function using Boolean algebra **(7)**

$$F(A,B,C)=A'BC+AB'C+ABC$$

(d) State and prove consensus theorem using Boolean algebra. **(8)**

3. (a) When is the tabulation method more preferable than the K-Map method for simplifying a Boolean function? **(5)**

(b) Convert $(0.625)_{10}$ to binary. Show every step of your calculation. **(4)**

(c) Design a combinational circuit with 3 inputs: x, y, and z, and 3 outputs: A, B, and C. When the binary input is 0, 1, 2, or 3, the binary output is two greater than the input. When the binary input is 4, 5, 6, or 7, the binary output is three less than the input. **(18)**

(d) Show the truth table for a three-state buffer. Construct a 2-to-1 line MUX with three-state buffers. **(3+5=8)**

Contd P/2

4. (a) Determine the output functions A as the sum of minterms and the output function B as the product of maxterms: **(16)**

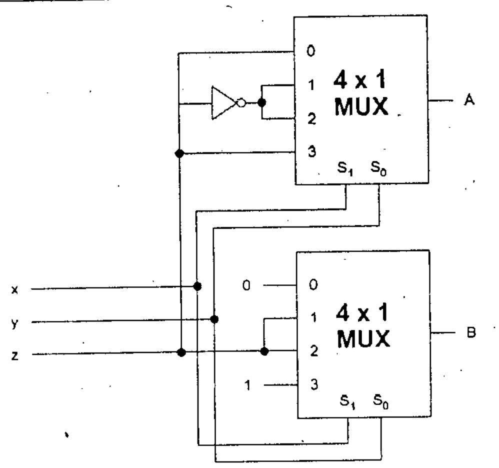


Figure for Question 4(a)

(b) Design a 4-bit BCD adder using 4-bit binary adders and basic logic gates. Use a block diagram to draw a binary adder. **(15)**

(c) An Octal to Binary Encoder may cause ambiguities if more than one inputs are simultaneously set to 1. How can this ambiguity be resolved? **(4)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What do you understand by mechanical switch contact bounce? Describe how S′ R′ latch can eliminate mechanical switch contact bounce. **(10)**

(b) Design a SR Flip-Flop using a D Flip-Flop and a 4 × 1 MUX. **(10)**

(c) A sequential circuit has two JK Flip-Flops A and B, two inputs x and y, and one output z. The Flip-Flop input equations and circuit output equation are given below: **(15)**

$$J_A = Bx + B'y' \qquad K_A = B'xy'$$
$$J_B = A'x \qquad K_B = A + xy'$$
$$z = Ax'y' + Bx'y'$$

Now draw the logic diagram of the circuit, tabulate the state table and derive the state equations for A and B.

CSE 205

6. (a) For the following primitive flow table shown in Fig. for Q. 6(a) answer the following questions: **(10+5+5=20)**

   (i) Find all compatible pairs by means of an implication table.

   (ii) Find the maximal compatibles by means of a merger diagram.

   (iii) Find a minimal set of compatibles that covers all the states and is closed.

	00	01	11	10
a	(a), 0	b , –	– , –	e , –
b	a , –	(b), 0	c , –	– , –
c	– , –	d , –	(c), 0	h , –
d	a , –	(d), 1	– , –	– , –
e	a , –	– , –	f , –	(e), 0
f	– , –	g , –	(f), 0	h , –
g	a , –	(g), 0	– , –	– , –
h	a , –	– , –	– , –	(h), 0

Fig. for Q. 6 (a)

(b) Design a 3-bit synchronous Gray Code Counter. Use JK Flip-Flops for your design. Show the state diagram, state table, function equations and the circuit diagram of your design. **(15)**

7. (a) Investigate the transition table of Fig. for Q. 7(a) and determine all race conditions and whether they are critical or noncritical. Determine also whether there are any cycles. **(10)**

y_1y_2 \ x_1x_2	00	01	11	10
00	10	(00)	11	10
01	(01)	00	10	10
11	01	00	(11)	(11)
10	11	00	(10)	(10)

Fig. for Q. 7 (a)

CSE 205

Contd... Q. No. 7

(b) Find a critical race-free state assignment for the reduced flow table shown in Fig. for Q. 7(b) using Multiple-row method. **(10)**

	00	01	11	10
a	(a)	c	(a)	d
b	a	(b)	c	(b)
c	(c)	(c)	(c)	d
d	(d)	b	a	(d)

Fig. for Q. 7 (b)

(c) Write the difference between ROM and PLA. A combinational circuit is defined by the following functions: **(5+10=15)**

$$F1(A, B, C) = \sum(0, 1, 2, 4)$$
$$F2(A, B, C) = \sum(0, 5, 6, 7)$$

Implement the circuit with a PLA having three inputs, four product terms and two outputs.

8. (a) Design a 4-bit Ripple counter using D Flip-Flops and briefly explain its operation. **(10)**

   (b) Design a 4-bit Johnson Counter. What is the disadvantage of Johnson Counter? What is the difference between Johnson Counter and Ring Counter? **(10)**

   (c) Design a 3-bit binary up counter that counts 1-2-5-7-1..., where any invalid state goes to the immediate next valid state in the sequence. Use T Flip-Flops for your design. Show the state diagram, state table, function equations, function minimization (if necessary) and the circuit diagram of your design. **(15)**

L-2/T-1/CSE **Date : 06/02/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **MATH 241** (Complex Variables and Statistics)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Prove that $|z_1 + z_2| \geq \big||z_1| - |z_2|\big|$ where z_1, z_2 are nonzero complex numbers. **(8)**

(b) Show that the equation $|z - z_0| = R$ represents a circle centered at z_0 and with radius R which can be written as $|z|^2 - 2\,\mathrm{Re}(z\overline{z_0}) + |z_0|^2 = R^2$. **(7)**

(c) Describe mathematically and graphically the region represented by $z(\bar{z} + 2) = 3$. **(10)**

(d) Find the principal argument of $z = \left(\sqrt{3} - i\right)^6$. **(10)**

2. (a) Test the continuity and differentiability of the function $f(z)$ at the point $z = 0$, where **(10)**

$$f(z) = \begin{cases} \dfrac{(\bar{z})^2}{z}, & z \neq 0 \\ 0\ , & z = 0 \end{cases}$$

(b) Find the bilinear transformation which maps the points $z_1 = 2$, $z_2 = i$ and $z_3 = -2$ into the points $w_1 = 1$, $w_2 = i$ and $w_3 = -1$, respectively. **(10)**

(c) Derive the Cauchy-Riemann equations and hence find the polar form of these equations. **(15)**

3. (a) Solve the equation $\sin z = 2$ by equating the real and imaginary parts in the equation. **(10)**

(b) Show that Euler's formula $e^{i\theta} = \cos\theta + i\sin\theta$ continues to hold when θ is replaced by z. **(5)**

(c) Evaluate $\int_C (z^2 + 3z)\,dz$ along the circle $|z| = 2$ from (2,0) to (0,2). **(10)**

(d) Using Cauchy integral formula, find the value of the integral $\int_C \frac{dz}{\left(z^2+4\right)^2}$ around the circle $C: |z - i| = 2$, taken in the positive sense. **(10)**

Contd P/2

MATH 241

4. (a) State Laurent's theorem. Expand $f(z)=\dfrac{z}{(z-1)(2-z)}$ in a Laurent series valid in the region: (i) $1<|z|<2$, (ii) $0<|z-2|<1$. **(18)**

(b) State Cauchy's residue theorem and use this theorem to find the value of the integral $\int_C \dfrac{3z^3+2}{(z-1)(z^2+9)}dz$ taken counterclockwise around the circle (i) $|z-2|=2$ (ii) $|z|=4$. **(17)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. Evaluate the following integrals by using contour integration, **(17+18)**

(a) $\displaystyle\int_0^\infty \frac{\cos ax\, dx}{(x^2+b^2)^2}\ (a>0, b>0)$ (b) $\displaystyle\int_0^{2\pi} \frac{\cos 2\theta d\theta}{1-2a\cos\theta+a^2}\ (a^2<1)$

6. (a) You are given the following incomplete frequency distribution. It is known that the total frequency is 1000 and the median is 413.11. Estimate by calculation the missing frequencies and find the value of the mode. **(17)**

Class interval	Frequency
300-325	5
325-350	17
350-375	80
375-400	?
400-425	326
425-450	?
450-475	88
475-500	9

(b) Calculate coefficient of skewness by Karl Pearson's method and values of β_1 and β_2 from the following data: **(18)**

Class interval	Frequency
10-20	18
20-30	20
30-40	30
40-50	22
50-60	10

Contd P/3

MATH 241

7. (a) The following table gives the relative values of two variables. **(20)**

X:	42	44	58	55	89	98	66
Y:	56	49	53	58	65	76	51

Find the regression line of Y on X and X on Y. Find also the correlation coefficient between X and Y.

(b) A bulb manufacturing company claims that the average longevity of their bulb is 4 years with a standard deviation 0.16 years. A random sample of 10 bulbs gave mean longevity of 3.45 years. Does the sample mean justify the claim of the manufacturer? Use a 5 percent level of significance. (Necessary Chart 1 is attached) **(15)**

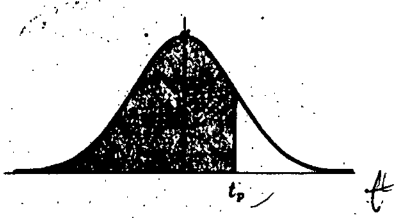
8. (a) A box contains 8 red, 3 white and 9 blue balls. If three balls are drawn at random, determine the probability that (i) all 3 are red (ii) 2 are red and 1 is white (iii) at least 1 is white. **(12)**

(b) The probability that an entering college student will graduate is 0.4. Determine the probability that out of 5 students (i) none (ii) at least 1 (iii) all will graduate. **(12)**

(c) A workshop produces 2000 units per day. The average weight of units is 130 kg. with a standard deviation of 10 kg. Assuming normal distribution, how many units are expected to weigh less than 142 kg? (Necessary Chart 2 is attached). **(11)**

Appendix III

Percentile Values (t_p)
for
Student's t Distribution
with ν Degrees of Freedom
(shaded area = p)



ν	$t_{.995}$	$t_{.99}$	$t_{.975}$	$t_{.95}$	$t_{.90}$	$t_{.80}$	$t_{.75}$	$t_{.70}$	$t_{.60}$	$t_{.55}$
1	63.66	31.82	12.71	6.31	3.08	1.376	1.000	.727	.325	.158
2	9.92	6.96	4.30	2.92	1.89	1.061	.816	.617	.289	.142
3	5.84	4.54	3.18	2.35	1.64	.978	.765	.584	.277	.137
4	4.60	3.75	2.78	2.13	1.53	.941	.741	.569	.271	.134
5	4.03	3.36	2.57	2.02	1.48	.920	.727	.559	.267	.132
6	3.71	3.14	2.45	1.94	1.44	.906	.718	.553	.265	.131
7	3.50	3.00	2.36	1.90	1.42	.896	.711	.549	.263	.130
8	3.36	2.90	2.31	1.86	1.40	.889	.706	.546	.262	.130
9	3.25	2.82	2.26	1.83	1.38	.883	.703	.543	.261	.129
10	3.17	2.76	2.23	1.81	1.37	.879	.700	.542	.260	.129
11	3.11	2.72	2.20	1.80	1.36	.876	.697	.540	.260	.129
12	3.06	2.68	2.18	1.78	1.36	.873	.695	.539	.259	.128
13	3.01	2.65	2.16	1.77	1.35	.870	.694	.538	.259	.128
14	2.98	2.62	2.14	1.76	1.34	.868	.692	.537	.258	.128
15	2.95	2.60	2.13	1.75	1.34	.866	.691	.536	.258	.128
16	2.92	2.58	2.12	1.75	1.34	.865	.690	.535	.258	.128
17	2.90	2.57	2.11	1.74	1.33	.863	.689	.534	.257	.128
18	2.88	2.55	2.10	1.73	1.33	.862	.688	.534	.257	.127
19	2.86	2.54	2.09	1.73	1.33	.861	.688	.533	.257	.127
20	2.84	2.53	2.09	1.72	1.32	.860	.687	.533	.257	.127
21	2.83	2.52	2.08	1.72	1.32	.859	.686	.532	.257	.127
22	2.82	2.51	2.07	1.72	1.32	.858	.686	.532	.256	.127
23	2.81	2.50	2.07	1.71	1.32	.858	.685	.532	.256	.127
24	2.80	2.49	2.06	1.71	1.32	.857	.685	.531	.256	.127
25	2.79	2.48	2.06	1.71	1.32	.856	.684	.531	.256	.127
26	2.78	2.48	2.06	1.71	1.32	.856	.684	.531	.256	.127
27	2.77	2.47	2.05	1.70	1.31	.855	.684	.531	.256	.127
28	2.76	2.47	2.05	1.70	1.31	.855	.683	.530	.256	.127
29	2.76	2.46	2.04	1.70	1.31	.854	.683	.530	.256	.127
30	2.75	2.46	2.04	1.70	1.31	.854	.683	.530	.256	.127
40	2.70	2.42	2.02	1.68	1.30	.851	.681	.529	.255	.126
60	2.66	2.39	2.00	1.67	1.30	.848	.679	.527	.254	.126
120	2.62	2.36	1.98	1.66	1.29	.845	.677	.526	.254	.126
∞	2.58	2.33	1.96	1.645	1.28	.842	.674	.524	.253	.126

Source: R. A. Fisher and F. Yates, *Statistical Tables for Biological, Agricultural and Medical Research* (5th edition), Table III, Oliver and Boyd Ltd., Edinburgh, by permission of the authors and publishers.

Chart 1 for Q. No 7(b)

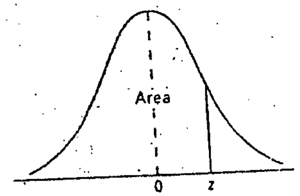


TABLE A.3 Areas Under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
−3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
−3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
−3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0352	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0722	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

TABLE A.3 (continued) Areas Under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9278	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Chart 2 for Q no 8(c)

= 9 =