L-2/T-1/CSE Date : 31/12/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Explain the operating principle of a Silicon controlled Rectifier with the help of 'Two transistor model'. **(20)**

   (b) Draw the I-V characteristics of an SCR and a TRIAC. **(10)**

   (c) Sketch the output wave form of the following circuit given in Fig. for Q. 1(c)(i) assuming output wave is obtained across the resistance. The input waveform and gate pulse sequence is given in Fig. for Q. 1(c)(ii). **(16⅔)**

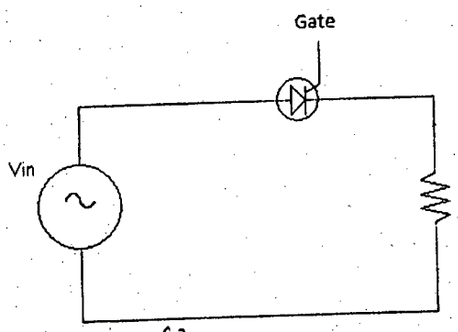

Fig for question 1.(c)(i):

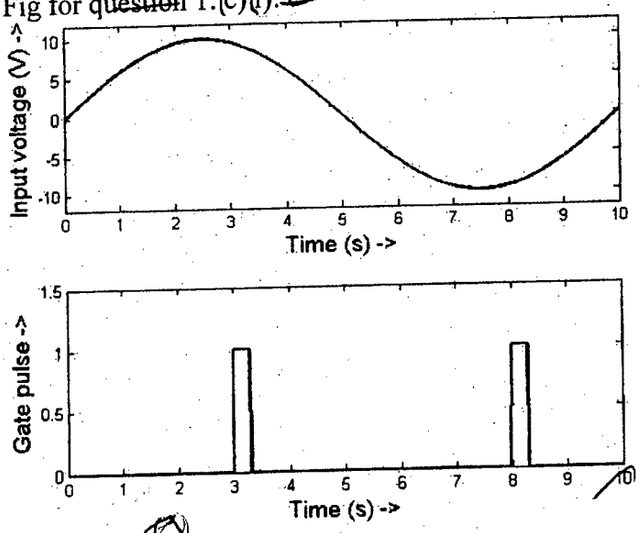

Fig for question 1. (c) ii):

2. (a) Draw the circuit diagram of a –20 dB/dec low pass filter. Also write down the design procedure. Design a –20 dB/dec low pass filter which has a cut off frequency of 100 kHz. **(16)**

   (b) Write down the properties of an ideal Op-Amp. **(10)**

   (c) Propose a circuit using Op-Amp which will produce following as output. **(20⅔)**

$$V_{out} = -4V_1 + 2V_2 + 7\frac{dV_1}{dt} - 8\int V_2\, dt$$

Here, V_1 and V_2 are two different input sources.

Contd P/2

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3. (a) Draw the circuit diagram of an inverting logarithmic amplifier and derive the expression of its output voltage. **(26⅔)**

(b) Determine all node voltages and drain current of the given circuit. Assume that, $V_t = 1$ V, $K'_n W/L = 1$ mA/V^2, $\lambda = 0$. **(20)**

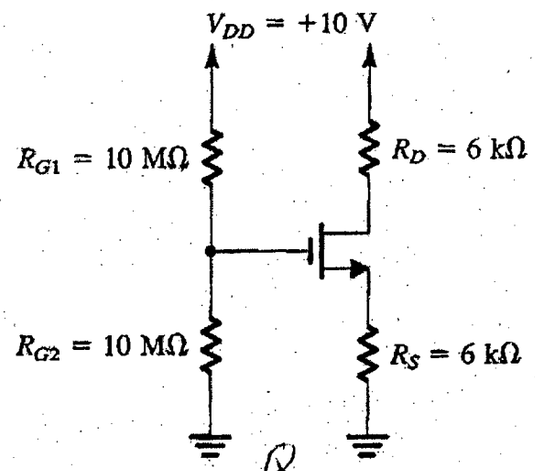

Fig for question 3.(b)

4. A common source amplifier circuit is shown in Fig. for Q. 4. **(46⅔)**

(a) Prove that, this circuit is operating in saturation region.

(b) Draw small signal equivalent circuit.

(c)Find: g_m, R_{in}, R_{out}, A_v and G_v

Assume following information as necessary, $V_t = 1$ V, $K'_n W/L = 2$ mA/V^2, $V_A = 100$ V.

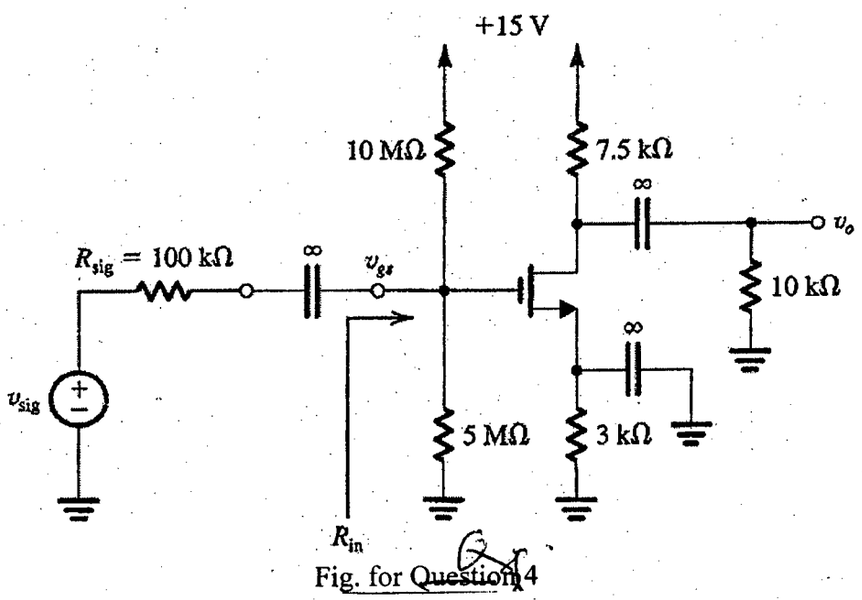

Fig. for Question 4

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SECTION – B

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

5. (a) Assuming the diodes to be ideal, find the values of I and V in the circuits shown in Fig. for Q. No. 5(a). **(16)**

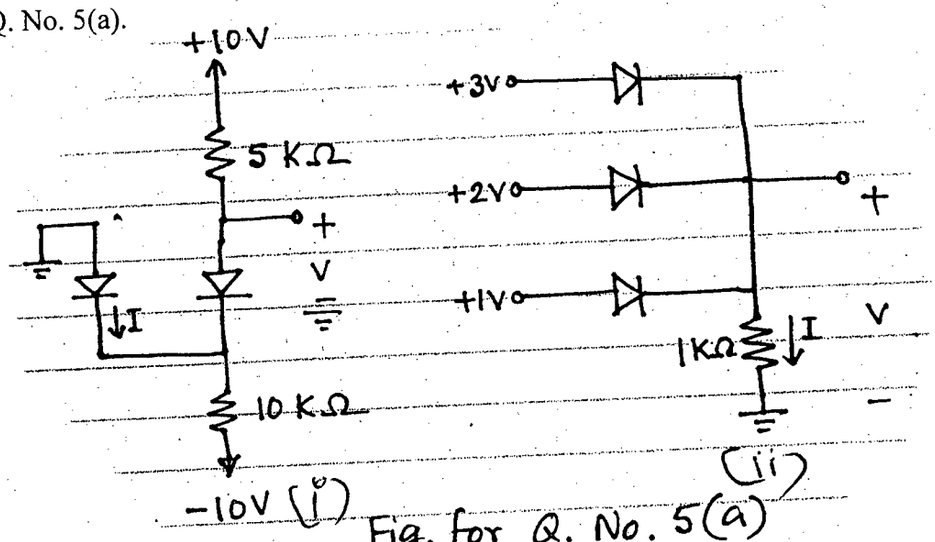

Fig. for Q. No. 5(a)

(b) Sketch the output waveform and transfer characteristics for the circuit shown in Fig. for Q. No. 5(b). Assume the diode to be ideal and V_s is a sinusoid with 5 V peak amplitude and frequency 5 kHz. **(15)**

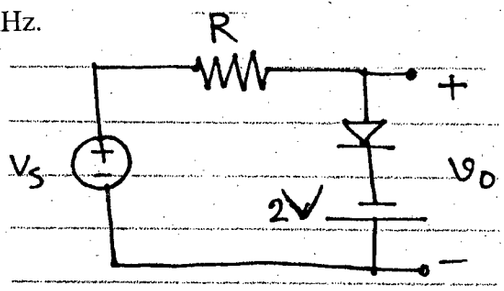

Fig. for Q. No. 5(b)

(c) A circuit for charging a 10 V battery is shown in Fig. for Q. No. 5(c). If V_s is a sinusoid with 20 V peak amplitude, find the fraction of each cycle during which the diode conducts. Assume that the diode is ideal. Also find the peak value of the diode current and the maximum reverse bias voltage that appears across the diode. **(15⅔)**

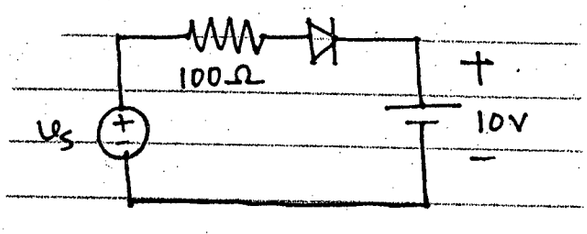

Fig. for Q. No. 5(c)

Contd P/4

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6. (a) Show that the average output voltage of a Bridge rectifier circuit is $V_o \cong \frac{2}{\pi} V_S - 2V_{DO}$. If the input voltage is a 12 V (rms) sinusoid and the load resistance is 100 Ω, calculate (i) the average output voltage, (ii) the peak diode current and (iii) the PIV of the diodes. Assume $V_{DO} = 0.7$ V. **(16⅔)**

(b) Determine the current I_D and diode voltage V_D for the circuit in Fig. for Q. No. 6(b) **(18)**

using

(i) Piecewise Linear model ($V_{DO} = 0.7$ V, $r_D = 20$ Ω)

(ii) Constant voltage drop model ($V_{DO} = 0.7$ V)

(iii) Ideal diode model.

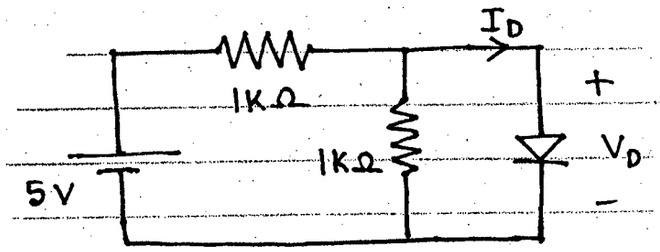

Fig. for Q. No. 6(b)

(c) Design a clamper circuit to perform the function indicated in Fig. for Q. No. 6(c) using ideal diode. **(12)**

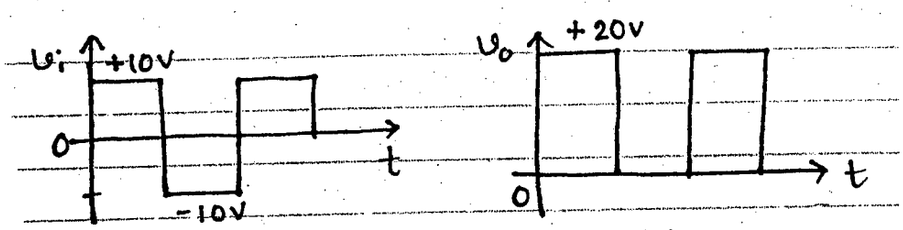

Fig. for Q. No. 6(c)

7. (a) For the circuit shown in Fig. for Q. 7(a) determine R_1 and R_C if $I_B = 0.02$ mA and $V_{CE} = 10$ V. **(16**

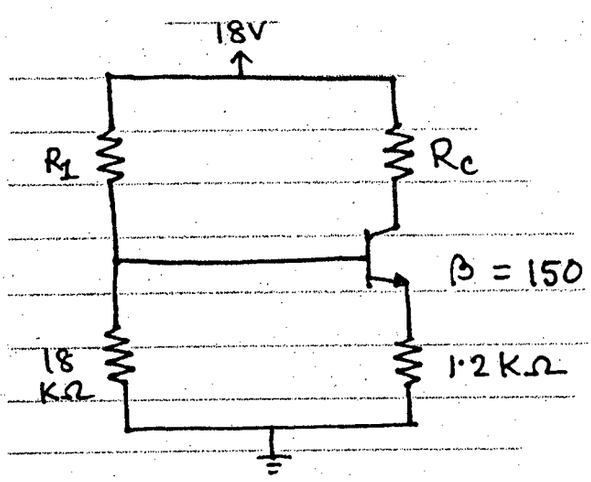

Fig. for Q. No. 7(a)

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Contd ... Q. No. 7

(b) For Fig. for Q. No. 7(b), find out the maximum collector current that the device can support. If the operating point is set for that maximum current, what kind of problem will we face if we want to use the device as a linear amplifier? **(12⅔)**

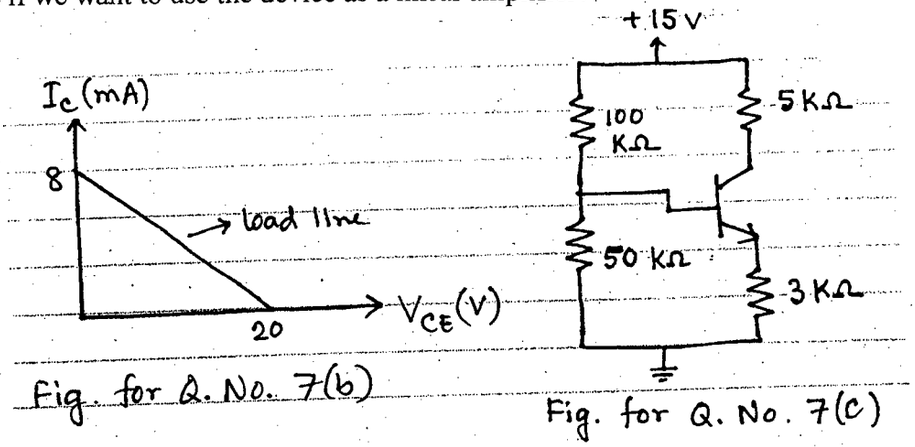

Fig. for Q. No. 7(b)

Fig. for Q. No. 7(c)

(c) Determine all node voltages and branch currents for the circuit shown in Fig. for Q. No. 7(c). Assume $\beta = 100$ and $V_{BE} = 0.7$ V. **(18)**

8. (a) Why biasing is needed for an amplifier using BJT? Draw the output characteristics of a BJT connected in CE configuration. Define early effect. **(10⅔)**

(b) Consider the emitter degenerated CE circuit of Fig. for Q. No. 8(b). **(36)**

(i) Find the DC current I_C and DC voltage V_C, V_B and V_E. Assume $\beta = 100$, $V_{BE} = 0.7$ V.

(ii) What are the allowable signal swings at the collector in both directions?

(iii) Determine the values of the BJT small signal model parameter: r_π, r_e, g_m at this bias point.

(iv) Draw the complete small signal equivalent circuit of the amplifier using suitable model of BJT. Neglect r_o.

(v) Find the value of R_e that results in R_{in} equal to four times the source resistance R_{sig}.

(vi) For this value of R_e, find A_{vo}, R_{out}, A_v, G_v and A_{is} of the amplifier.

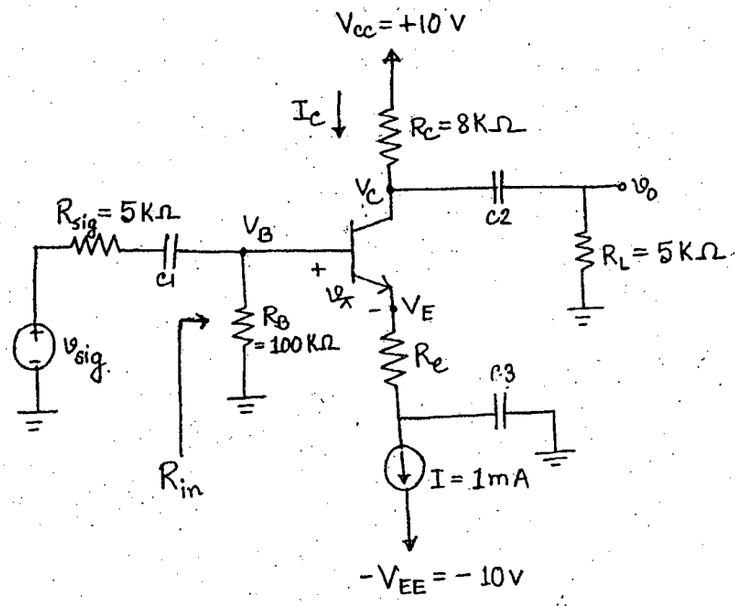

Fig. for Q. No. 8(b)

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L-2/T-1/CSE **Date : 31/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

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

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Here, V_1 and V_2 are two different input sources.

Contd P/2

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SECTION – B

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

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Contd P/4

EEE 263

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PIV →

(b) Determine the current I_D and diode voltage V_D for the circuit in Fig. for Q. No. 6(b) using **(18)**

(i) Piecewise Linear model ($V_{DO} = 0.7$ V, $r_D = 20$ Ω)

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↑ capital C

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Contd P/5

EEE 263

Contd ... Q. No. 7

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(vi) For this value of R_e, find A_{vo}, R_{out}, A_v, G_v and A_{is} of the amplifier.

Jubaimoon
24.12.12

L-2/T-1/CSE **Date : 24/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Design a sequential circuit that detects a sequence of three or more consecutive 1s in a string of bits coming through an input line. Use D flip-flops. The design must include the following: **(15)**

   (i) State diagram

   (ii) State table

   (iii) Simplified logic equations

   (iv) Logic diagram

   (b) Draw and explain the operation of a Master-Slave D flip-flop. **(12)**

   (c) Differentiate Mealy and Moore models. **(4)**

   (d) Show the logic diagram and function table of an SR latch with NAND gates. **(4)**

2. (a) Develop a synchronous 3-bit counter with a Gray code sequence using JK flip-flops. (Hints: Gray code count sequence for a 2-bit counter is: 00, 01, 11, 10, 00, 01, ...) **(18)**

   (b) Draw the logic diagram of a serial adder. Show the values of inputs and outputs of all components (e.g., flip-flop, register) used in the design after every clock pulse while adding the following two numbers 0101 and 0011. **(6+6)**

   (c) Draw the logic diagram of a four-stage switch-tail ring counter. **(5)**

3. (a) Draw and explain a four bit binary count up ripple counter with T flip-flops. **(12)**

   (b) Convert a D-flip-flop to a T-flip-flop. Use necessary gates. **(4)**

   (c) Derive the characteristic table and the characteristic equation for a JK flip-flop. **(4)**

   (d) Implement the following three Boolean functions with a PLA: **(15)**

   $F_1 = \sum (0, 1, 2, 4)$

   $F_2 = \sum (0, 5, 6, 7)$

   $F_3 = \sum (0, 3, 5, 7)$

Contd P/2

CSE 205

4. (a) A specification is given below for a gated latch circuit with two inputs G and D and an output Q. Assume fundamental mode operation. **(6+6)**

"Binary information present at the D input is transferred to the Q output when G is equal to 1. The Q output will follow the D input as long as G = 1. When G goes to 0, the information that was present at the D input at the time the transition occurred is retained at the Q output".

Derive the primitive flow table and then obtain the reduced flow table.

(b) What is a race in fundamental mode circuits? Explain critical and non-critical races with example. **(4+8)**

(c) Write down the procedure to assign the output to unstable states in a flow table. **(7)**

(d) Write down the restrictions on the duration of input for pulse mode asynchronous circuits. **(4)**

SECTION – B

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

5. (a) Design a circuit that takes a 4-bit number as input and produces the 2's complement of the given number. **(20)**

(b) Using the two-level forms of logic (i) NOR-OR, and (ii) OR-NAND, implement the following Boolean function F: **(6+6)**

$$F(A, B, C, D) = \sum (0, 4, 8, 9, 10, 11, 12, 14)$$

Assume that both the normal and complement inputs are available.

(c) Define prime implicants. **(3)**

6. (a) Design a 4-input priority encoder and show the gate level circuit diagram. **(12)**

(b) Design a 3-8 decoder using two 2-4 decoder circuits. **(8)**

(c) Implement the following function F using one 4×1 multiplexer and basic gates: **(15)**

$$F(A, B, C, D) = \sum (1, 3, 4, 11, 12, 13, 14, 15)$$

7. (a) Design a 4-bit incrementer circuit by using 4 half-adders. Note that the incrementer circuit adds 1 to a binary number. **(10)**

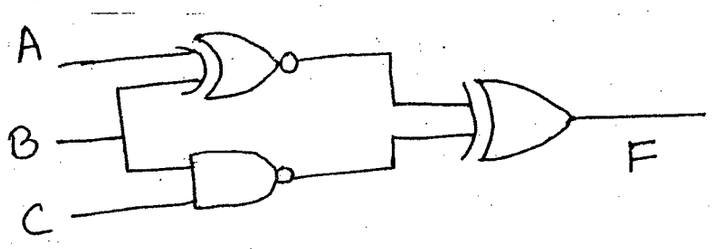
(b) The Boolean expression for an X-OR gate is AB′ + A′B. With this as a starting point, use DeMorgan's theorems and other rules or laws to find a simplified expression for an X-NOR gate. **(8)**

Contd P/3

CSE 205

Contd ... Q. No. 7

(c) Analyze the following circuit and determine the output F as sum of minterms and product to maxterms. **(9)**



(d) Give an example of the non-associativity of the 3-input NOR operator. **(8)**

8. (a) Simplify the following Boolean function by using the tabulation method: **(15)**

$$F(A, B, C, D) = \Sigma (0, 1, 2, 8, 10, 11, 14, 15)$$

(b) Convert $(41.6875)_{10}$ to binary. **(5)**

(c) Perform the subtraction with the following binary unsigned numbers using (i) 2's complement, (ii) 1's complement: 11010-1101. **(10)**

(d) Prove that $x(x + y) = x$. **(5)**

L-2/T-1/CSE **Date : 19/11/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2011-2012

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**.

All the questions in this section are related to C++ Programming.

1. (a) What is an in-line function? What are its advantages and disadvantages? Why might the following function not be in-lined by your compiler? **(2+4+2=8)**

```
void f1 () {for (int i = 0; i < 10; i++) cout << i;}
```

(b) The class **coord** is defined as follows **(2+4+4=10)**

```
class coord {
        int x, y;
public:
        coord(int i = 0; int j = 0) { x = i; y = j;}
        void getxy(int &i, int &j) { i = x; j = y;}
};
```

Make necessary changes to the **coord** class and overload the + operator so that it accepts the following types of operations:

ob + int; and int + ob;

Avoid any use of unnecessary **friend** function.

(c) What is a reference? Classify references used in C++ programming. **(2+3+5=10)**

Explain with examples how a returning reference can allow a function to be used on the left side of an assignment.

(d) Explain with appropriate examples how to obtain the addresses of two overloaded methods in C++ programming. **(7)**

2. (a) The class **dyna** is defined as follows: **(4+2+3+4=13)**

```
class dyna {
        int *p;
public:
        dyna(int i);
        ~dyna(){ free(p);}
        int get() { return *p}
};
```

Contd P/2

CSE 201

Contd Q. No. 2(a)

Write the constructor **dyna(int *i*)** based on its prototype given in class declaration. Also write a function called **neg()** that reverses the sign of its integer parameter.

What will be the problem if the following statement is executed in the **main()** function?

```
Cout << neg(ob);
```

where **ob** is an instance of **dyna** class defined in the **main()** function.

Write a copy constructor to solve the above mentioned problem.

(b) What is a default argument? With appropriate examples explain how a default argument produces constructor overloading ambiguity. **(3+3=6)**

(c) When a base class is inherited as public, protected or private by the derived class, what happens to its public members? What happens to its protected and private members? **(9)**

(d) Given the following fragment, in what order are the constructor functions called? In what order are the destructor functions called? **(3)**

```
class myclass : public A, public B, public C {.....};
```

(e) Define virtual base class with examples. Explain why a virtual base class might be necessary. **(2+2=4)**

3. (a) What is meant by a template class? Give three examples. **(5)**

(b) Explain two different formatted I/O handling techniques used in C++ programming. **(8+4=12)**

Write down a manipulator function that prints a floating point output using width = 10, precision = 4 and filling the blank spaces using the letter '*'.

(c) Create an inserter and an extractor for the following **inventory** class: **(5+5=10)**

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

(d) Write a C++ program to check whether a file contains any fatal I/O error or not using the enumeration **iostate**. **(8)**

Contd P/3

CSE 201

4. (a) Define virtual function and pure virtual function with appropriate examples. Differentiate between early binding and late binding used in object oriented programming. **(3+3+4=10)**

(b) Define generic class with appropriate examples. Write a generic class **stack** that can produce instances for stack of integers, stack of doubles and stack of characters. **(5+15=20)**

(c) What is namespace? Write down the problems of using global namespaces. **(5)**

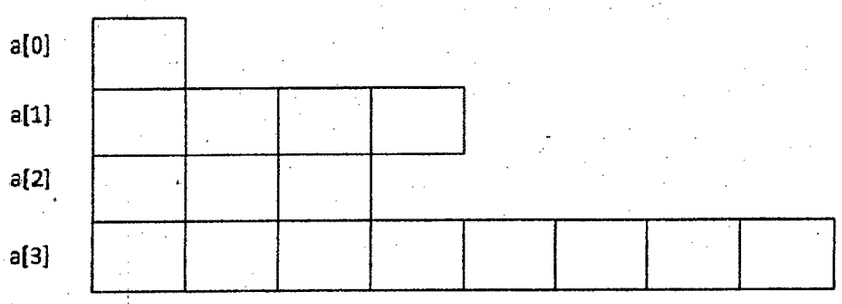
SECTION – B

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

5. (a) Write a short note on the lifetime of an object in Java. **(6)**

(b) Discuss the access levels of a constructor method of a class in Java. **(8)**

(c) Write a code fragment to create the following multidimensional integer array using **only one loop**. **(10)**



(d) Write the use of "abstract" and "final" keywords in Java with example. **(7)**

(e) Why does the "main" method of a Java program not require an "argc" type parameter while dealing with command line arguments? **(4)**

6. (a) Write a short note on "interface" in Java. **(10)**

(b) What is the purpose of the method "finalize" present in the class "Object"? Why is its use discouraged? **(5+3=8)**

(c) What is run-time polymorphism? How does Java achieve run-time polymorphism? **(6)**

(d) The members of a class "Record" are: **(3+8=11)**

- A String called "id"
- A String called "recordDate"
- A double called "amount"

The objects of this class will be stored in a file. Give the definition of this class.

Now assume that the file "recordList.dat" contains ten instances of Record.

Write a code fragment to read these ten objects into a Record array.

Contd P/4

CSE 201

7. (a) What are the two ways of creating a thread? Give an example for each kind. **(4+4=8)**

(b) Consider the producer-consumer problem where two threads share a common buffer of size 1. One of the threads called the producer, puts an object into the buffer and the other thread, the consumer, takes it out. The producer cannot put an object into the buffer if it is already full and the consumer cannot take an object out of the buffer if it is empty. **(18)**

Write Java code to solve the above mentioned problem using the concept of inter-thread communication. **(9)**

(c) Draw a schematic diagram of the different states of a thread. **(5)**

8. (a) How is a Java Applet run?

(b) Write both Java and HTML code for an Applet program that displays "Hello World". **(8)**

(c) What are the keywords that are associated with exception handling in Java? Write the use of each keyword. **(10)**

(d) Write a Java program that illustrates re-throwing an exception. **(4)**

(e) What are the different ways of event handling in java? **(8)**

L-2/T-1/CSE **Date : 17/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Prove that $O(n^3)\ O(n) = O(n^4)$. **(5)**

   (b) Write the main three reasons why we usually concentrate on finding the worst-case running time of an algorithm. **(5)**

   (c) Write an algorithm for DFS traversal of a given graph. Analyze the time-complexity of the algorithm. **(10+5=15)**

   (d) Write the sequences of the vertices if you explore the following graph G using BFS and DFS. Classify the edges of G for your DFS traversal. **(4+6=10)**

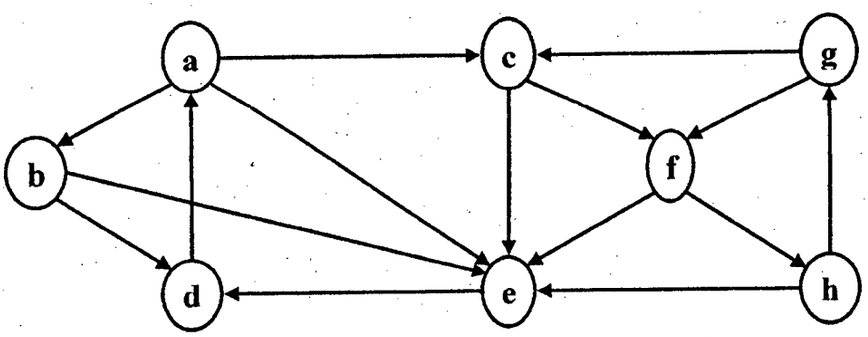


Figure for Question 1(d)

2. (a) What is the divide-and-conquer technique? **(5)**

   (b) Write the merge sort algorithm. Analyze the time-complexity of the algorithm. **(10+5=15)**

   (c) Write the recurrence relation of the merge sort algorithm. Draw the recursion tree for the recurrence relation of the merge sort algorithm. **(7)**

   (d) Sort the array 15, 13, 9, 5, 12, 8, 7, 4, 10, 6, 2, 1, 26, 23 using heap sort showing the values in the right of the nodes. **(8)**

3. (a) Write the quick sort algorithm. Simulate the quick sort algorithm on the array of Question 2(d) showing in detail how partition routine works. **(8+7=15)**

   (b) What is a priority queue? Write three applications of a priority queue. **(2+3=5)**

   (c) What are the main operations of a priority queue? Explain how one can implement these operations using a heap. **(15)**

Contd P/2

CSE 203

4. (a) Explain the advantages and disadvantages of arrays and linked-lists. **(5)**

(b) What is a tree? Write an algorithm for finding the height of a tree. Analyze the time-complexity of the algorithm. **(2+5+5=12)**

(c) Let T be a binary tree with height h. Then prove that the number of nodes in T is at least $2h + 1$ and at most $2^{h+1} - 1$. **(12)**

(d) Write pseudocodes for Insert and Delete operations of a circular queue. **(6)**

SECTION – B

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

5. (a) Explain the insertion and deletion operations in a binary search tree with illustrative examples. **(14)**

(b) Sort the following data set using counting sort showing every step of the algorithm. **(11)**

$A = \{6, 0, 2, 0, 1, 3, 4, 6, 1, 3, 2\}$

(c) "An important property of counting sort is that it is stable" – explain. **(4)**

(d) Analyze the average case running time for bucket sort. **(6)**

6. (a) 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 a probabilistic skip-list. **(7+8=15)**

key	3	6	7	9	12	17	19	21	25	26
No. of consecutive heads	1	4	1	2	1	2	1	1	3	1

Do the following operations on the skip-list and show the procedures.

(i) Search 21

(ii) Insert 22 with 3 consecutive heads

(iii) Delete 19

(iv) Search 18

(b) Show that the expected running time of searching in a probabilistic skip-list is $O(\log n)$. **(6)**

(c) Consider inserting the keys 18, 41, 22, 44, 59, 32, 31, 73 into a hash table of length $m = 13$ using double hashing with $h_1(k) = k \bmod 13$,

$$h_2(k) = 8 - (k \bmod 8).$$

Draw the hash table. **(10)**

(d) What are the properties of a good hash function? **(4)**

Contd P/3

CSE 317

Contd ... Q. No. 6

(c) Solve the following problem using Third-Order RK method over the interval from x = 0 to x = 1 with a step size of h = 0.5 where y(0) = 1. **(11)**

$$y' = x^3y - 1.5y$$

Use the following version of Third-Order RK method.

$$y_{i+1} = y_i + h\,(k_1 + 4k_2 + k_3)/6$$

where,

$$k_1 = f(x_i, y_i)$$

$$k_2 = f(x_i + h/2, y_i + k_1h/2)$$

$$k_3 = f(x_i + h, y_i - k_1h + 2k_2h)$$

7. (a) Derive the integral of the following tabular data using best combination of Trapezoidal rule and Simpson's rule. **(10)**

x	1	2	3	5	6	7	8
f(x)	–1	1	3	7	9	11	13

(b) Fit the function $f(x; a, b) = a\,(1 - e^{-bx})$ to the data: **(25)**

x	0.25	0.75	1.25	1.75	2.25
y	0.28	0.57	0.68	0.74	0.79

Use initial guesses of a = 1.0 and b = 1.0 for the parameters.

8. (a) Use Romberg integration with an accuracy of $O(h^8)$ to integrate the following function from x = 0 to x = 0.8. **(15)**

$$f(x) = 7x^3 + 4x^2 + 5x + 3$$

(b)Integrate $y' = 4e^{0.8x} - 0.5y$ from x = 0 to x = 1 with a step size of 0.5 using the following methods: **(20)**

(i) Heun's method

(ii) Midpoint method

Given, y(0) = 2.

CSE 481

8. (a) Explain why **Si** is used for wafer processing. **(5)**

(b) Describe the effect of **collector resistance** R_c on the propagation delay of Bi-CMOS. **(5)**

(c) Explain why Bi-CMOS is faster than CMOS for high capacitive load, but slower for low capacitive load. **(15)**

(d) Show that, for clocked-CMOS, **charge leakage** places a lower limit on allowable clock frequency and it is **(10)**

$$f = (1/t_h) \text{ where } t_h = (C_{out}/I_L)(V_l - V_x)$$

L-2/T-1/CSE **Date : 17/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

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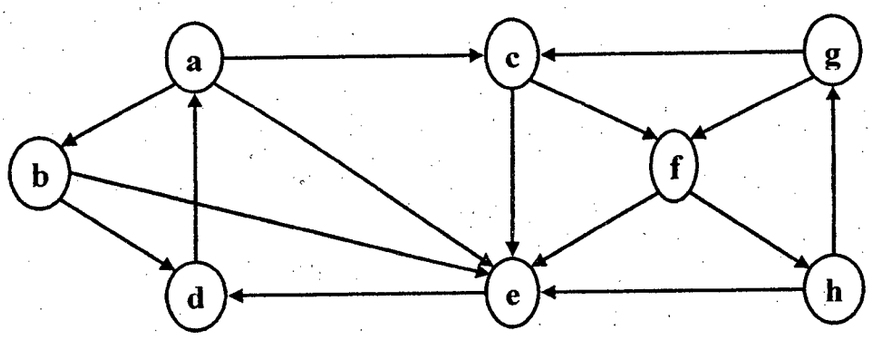

Figure for Question 1(d)

2. (a) What is the divide-and-conquer technique? **(5)**

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Contd P/2

CSE 203

4. (a) Explain the advantages and disadvantages of arrays and linked-lists. **(5)**

(b) What is a tree? Write an algorithm for finding the height of a tree. Analyze the time-complexity of the algorithm. **(2+5+5=12)**

(c) Let T be a binary tree with height h. Then prove that the number of nodes in T is at least $2h + 1$ and at most $2^{h+1} - 1$. **(12)**

(d) Write pseudocodes for Insert and Delete operations of a circular queue. **(6)**

SECTION – B

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

5. (a) Explain the insertion and deletion operations in a binary search tree with illustrative examples. **(14)**

(b) Sort the following data set using counting sort showing every step of the algorithm. **(11)**

$A = \{6, 0, 2, 0, 1, 3, 4, 6, 1, 3, 2\}$

(c) "An important property of counting sort is that it is stable" – explain. **(4)**

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Draw the hash table. **(10)**

(d) What are the properties of a good hash function? **(4)**

Contd P/3

CSE 203

7. (a) When do we call a binary search tree an AVL tree? Show that the height of an AVL tree storing n items is O (log n). **(3+7=10)**

   (b) Describe single rotation and double rotation operations on AVL tree. **(8)**

   (c) Perform the following operations on the AVL tree of Figure 2 and draw the corresponding AVL trees. **(7)**

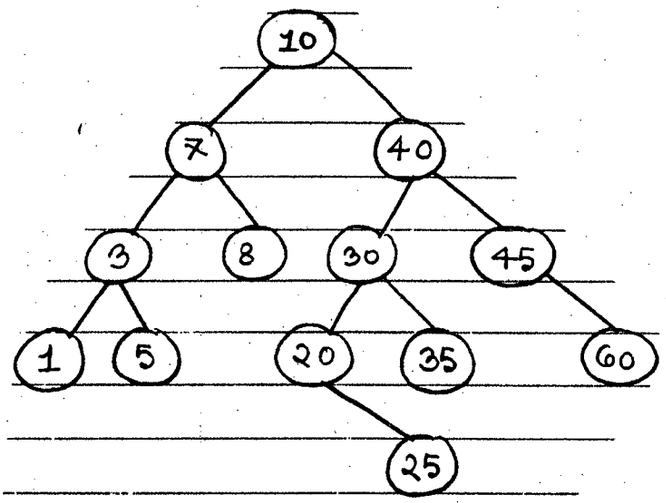

Figure 2 of Question 7(c).

   (i) Insert 9

   (ii) Insert 29

   (iii) Delete 30

   (d) Write algorithms for any two open addressing schemes of collision resolution in a hash table. **(10)**

8. (a) Prove that a red black tree with n internal nodes has a height at most 2 (log (n + 1)). **(8)**

   (b) Write down the properties of a red black tree. **(4)**

   (c) Insert the letters 'A', 'L', 'G', 'O', 'R', 'I', 'T', 'H', 'M' in order into a blank red-black tree and also delete the letters 'A', 'L', 'G', 'O' in order from the constructed red black tree. **(9+6=15)**

   (d) Show the steps for sorting the following numbers using least significant digit radix sort. **(8)**

   275, 087, 426, 061, 509, 170, 677, 503

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L-2/T-1/CSE **Date : 07/01/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Find all the roots of $\left(-2\sqrt{3}-2i\right)^{1/4}$. **(10)**

   (b) Show that the equation $\left|z+\frac{1}{z}\right|=2$ represents two circles with centres (0, 1), (0, –1) and radius $\sqrt{2}$. **(10)**

   (c) Prove that $u = e^{-x}\left(x\sin y - y\cos y\right)$ is harmonic. Find its harmonic conjugate v and express u + iv as an analytic function of z. **(15)**

2. (a) If f(z) is an analytic function of z prove that $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2$. **(10)**

   (b) Find the polar form of Cauchy-Riemann equations $u_x = v_y$ and $u_y = -v_x$ and hence find the Lappace's equation in polar form. **(15)**

   (c) Express sinhz in the complex form a + ib and show that $|\sinh z|^2 = \sinh^2 x + \sin^2 y$. **(10)**

3. (a) State and prove Cauchy integral formula. Use this formula to evaluate $\int_C \frac{z}{z^2+1}dz$ where C is the circle $|z + i| = 1$. **(18)**

   (b) Evaluate $\int_C \frac{z^4+1}{z^2(z+2)(2z+1)}dz$ where C is the circle $|z| = 1$. **(17)**

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

   (b) Show that the transformation $w=\frac{5-4z}{4z-2}$ transforms the circle $|z| = 1$ into a circle in the w plane. Find the centre and radius of this circle. **(17)**

Contd P/2

MATH 241

SECTION – B

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

5. Evaluate the following integrals by using Contour integration: **(17+18)**

(a) $\int_{-\infty}^{\infty} \frac{x \sin \pi x \, dx}{x^2 + 2x + 5}$ (b) $\int_{0}^{\infty} \frac{x^2 dx}{(x^2+9)(x^2+4)^2}$

6. (a) From the data given below calculate Pearson's first coefficient of Skewness and Kurtosis. Comment on the nature of the distribution. **(20)**

Age in years:	21 – 26	27 – 32	33 – 38	39 – 44	45 – 50	51 – 56
No. of persons:	83	75	176	130	92	54

(b) A time study was conducted in a factory with the help of two samples A and B consisting of 7 workers. The time taken by the workers in each case was recorded. From the information given below state which of the samples is more variable and which takes less time on an average. **(15)**

Time taken in minutes

Sample A:	130	124	119	134	142	130	141
Sample B:	132	144	136	143	132	133	140

7. (a) Find the two regression lines and the coefficient of correlation from the table given below: **(20)**

X:	105	112	104	114	117	108	106	117	111
Y:	58	56	47	46	51	64	66	50	55

(b) (i) An insurance company finds that the probability of dying of an individual belonging to a certain age group within a year is 0.0005. If 1000 persons of this age group buy policy of this company, find the probability that the company will receive 5 or more claims during a given year. **(7)**

(ii) The probability that A can solve a problem is $\frac{3}{7}$, that B can solve it is $\frac{2}{3}$, that C can solve it is $\frac{4}{5}$. If all of them try independently, find the probability that the problem will be solved. **(8)**

Contd P/3

MATH 241

8. (a) Explain type-I error and type-II error. 9 items of a sample had the following values:

50, 48, 49, 53, 52, 47, 45, 46, 51

Can this sample be regarded as taken from the population having 47 as mean at 5% level of significance? (Given that for $\nu = 8$, $t_{0.05} = 3.355$) **(17)**

(b) 5 coins are tossed 3200 times and the number of heads appearing each time are noted. At the end, the following results were obtained. **(18)**

No. of heads:	0	1	2	3	4	5
Frequency:	80	570	1100	900	500	50

Test the hypothesis that the coins are unbiased at 5% level of significance. (Given that for $\nu = 5$, $\chi^2_{0.05} = 11.07$)
