L-2/T-1/CSE **Date : 09/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2012-2013

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 questions in this section are on Java.

1. (a) Write a class Animal that has name and age of animals as member variables. Write another class that will add 3 animals in an ArrayList of type Animal. Then remove the animal from this list named "Lion". Write necessary getter and setter methods for the Animal class. **(10)**

   (b) Design a user-interface where a TextArea and a button are added using Flow Layout. Every key the user types will be added on the TextArea and the program will exit when "–1" is pressed. **(9)**

   (c) A movie club contains many movies. Each movie has a title and one or more directors. A movie may be borrowed and returned from the club. Write a class Movie and another class MovieClub with appropriate instance variables and methods to implement the scenario. Also write a member method to return the current number of movies in the club. **(16)**

2. (a) Why BufferedReader is a preferred reader? Write a program that appends a string in an existing file named a.txt. **(3+8=11)**

   (b) What are the advantages of multithreading over process-based multi-tasking? Which are the two ways to create a thread and which of these is better? Explain the reason. **(4+6=10)**

   (c) Show two examples of using Super Keyword. **(4)**

   (d) Write a program that throws and catches exception when the value of a variable is greater than 1000. **(10)**

3. (a) Write an interface and a class that implements it. Write a program to show how objects can be created using interface. **(10)**

   (b) What are the properties of static variables and methods? Why the main() method is declared as static.? **(6+5=11)**

   (c) Write a Student class for a university enrolment tracking system that has the following instance variables: **(14)**

   id, name, course, number of units completed

   Write a method inc() that will increment the number of units completed by the student by one.

   Write another class from where create a student object, get the number of units already completed by this student and adjust the state of the student by calling inc(). Display the object's state.

Contd P/2

CSE 201

4. (a) Write down the differences between: **(5+5=10)**

   (i) abstract class and interface

   (ii) early binding and late binding

   (b) Write a method that accepts an array of Strings called SearchList and a search String called SearchKey as parameters. The method should determine and return the number of occurances of SearchKey in SerchList. **(8)**

   (c) Write a code segment to create a 2-D array of Integer class which will contain 4 rows. Each row will have 3, 1, 10 and 5 columns, respectively. **(7)**

   (d) Which protocol uses Datagram packet? Write a client program that wants to receive Datagram packet using port 1111. **(10)**

SECTION – B

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

All the questions in this section correspond to the programming language: C++.

5. (a) What is the function of inserter and extractor in C++? What is the problem with the following code segment? **(5+5+15=25)**

```
#include <iostream>
#include <cstring>
using namespace std;

class phonebook {
  char name[80];
  int areacode;
  int prefix;
  int num;

 public:
  phonebook(char *n, int a, int p, int nm)
  {
    strcpy(name, n);
    areacode = a;
    prefix = p;
    num = nm;
  }
 };

 // Display name and phone number.
 void operator<<(ostream &stream, phonebook o)
 {
   stream << o.name << " ";
   stream << "(" << o.areacode << ") ";
   stream << o.prefix << "-" << o.num << "\n";
  }
```

Contd P/3

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Contd... Q. No. 5

Now, write a class with inserter and extractor in C++ which draws a Circle object. The extractor should take the radius and center of the circle as input. Assume that, you have a DrawPixel (int x, int y) library function that draws pixel at coordinate(x,y). Also, write down the main function to coordinate the draw task.

(b) What is the output of the following code segment? **(5)**

```
class myclass {
        int  who;
public:
        myclass(int  n)
        {       who=n;
                cout<<"Constructing"<<who<<"\n";
        }
        ~myclass( ) { cout<<"Destructing"<<who<<"\n";}
        int  id( ) { return who; }
};

void  f ( myclass &o){ cout<<"Received"<<o.id()<<"\n"; }

int  main() {
        Myclass x(1);
        f(x);
        return 0; }
```

(c) Suppose, there are three classes A, B and C. Class C wants to inherit the properties of both class A and B. Describe two ways in which C can inherit both A and B simultaneously. Give examples, with code. **(5)**

6. (a) What do you mean by a generic class? Write C++ code to create a generic class *ARR*, which has the following features: **(5+20=25)**
   - * *ARR* can hold an array of any possible data-type.
   - * *ARR* can apply bubble-sort upon that array.
   - * *ARR* incorporates a member function called compact(). The compact() function is called with a pointer to the first element in the array, the number of elements in the array, and the starting and ending indexes of the elements to be removed. The function then removes those elements and moves the remaining elements down such that all unused elements are at the end.

   (b) What is function overloading? What is the basic difference between using an overloaded function and a generic function? **(5)**

   (c) How can you call a member function of a class without creating any object of that class? Explain. **(5)**

7. (a) What is a copy constructor? What are the three cases when a copy constructor is invoked? Give examples using code. **(10)**

   (b) Write down a function named "Compute_Volume" to compute the volume of a 3D rectangular box with height h, width w and length l. Then, write a new function

Contd P/4

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

"New_Compute_Volume" by changing the previous function a little so that it can compute the volume of a rectangular box as well as that of a cube. Remember that, a cube has only one parameter. The "New_Compute_Volume" function should be able to handle the following calls: **(7)**

* New_Compute_Volume (30,20,10);
* New_Compute_Volume (10,10,10);
* New_Compute_Volume (10);

(c) Write a class NoOfInstancesTracker, which contains a member function to keep track of the number of objects of a class that are in existence at any given point of time. Remember to use necessary primitives to ensure safety for shared resources and guarantee mutual exclusion. **(18)**

8. (a) What is the problem with the following code segment? **(10)**

```
class array {
        int *p;
        int size;
public:
        array(int sz) {
                try {
                        p = new int[sz];
                } catch (bad_alloc xa) {
                        cout << "Allocation Failure\n";
                        exit(EXIT_FAILURE);
                }
                size = sz;
        }
        ~array() { delete [] p; }

        void put(int i, int j) {
                if(i>=0 && i<size) p[i] = j;
        }

        int get(int i) {
                return p[i];
        }
};

void print (array &ob)
{
        array x=ob; // int i;
        for(i=0; i<10; i++) cout << x.get(i);
}

int main()
{
        array num(10);
        int i;
        for(i=0; i<10; i++) num.put(i, i);
        print(num);
        for(i=9; i>=0; i--) cout << num.get(i);
        cout << "\n";
        return 0;
}
```

Contd P/5

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(b) What is a friend function? Can a member function of a class be a friend function of another class? If not, mention the reasons behind it. If yes, give a code example. **(10)**

(c) What is a virtual function? What is the relation between run-time-polymorphism and virtual functions? **(10)**

(d) What is wrong with the following code segment? **(5)**

```
class base {
        int x;
public:
        void setx (int  n)  { x=n; }
        void showx( )  { cout<< x << "\n";}
};

class derived: private base{
        int y;
public:
        void sety (int  n)  { y=n; }
        void showy( )  { cout<< y << "\n";}
};

int main( ){
        derived ob;
        ob.setx(10);
        ob.sety(20);
        ob.showx();
        ob.showy();
        return 0;
}
```

L-2/T-1/CSE **Date : 12/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2012-2013

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) What is a data structure? Write the properties of a linear data structure. **(1+4=5)**

   (b) Prove that $5n^3 + 3n = O(n^4)$, but $5n^3 + 3n \neq O(n^2)$. **(5+5=10)**

   (c) Let a : $array[l_1..u_1, l_2..u_2, l_3..u_3]$ be a 3-dimensional array. Assume that b and c are the base address and component length of the array a, respectively. Then write the Array Mapping Function to calculate addr(a[i, j, k]). **(10)**

   (d) Write the advantages and disadvantages of arrays and linked-lists. **(10)**

2. (a) Write the differences between a standard queue and a priority queue. Write the property of a Max-Heap. Write an algorithm for building a Max-Heap. Analyze the time-complexity of the algorithm. **(3+3+7+7=20)**

   (b) Explain the divide-and-conquer technique? What is the function of the pivot element in the quick sort algorithm? **(3+2=5)**

   (c) Write two functions for the insertion and deletion operations in a circular linked list. **(5+5=10)**

3. (a) Write an algorithm for DFS traversal of a given graph. Analyze the time-complexity of the algorithm. **(8+7=15)**

   (b) Consider a graph G as shown in Figure for Question 3(b). Then **(6+4+4+6=20)**

   (i) Write the adjacency matrix and adjacency list of the graph G.

   (ii) Draw the BFS forest of the graph G by assuming b as the starting vertex.

   (iii) Write the sequence of vertices if you explore the graph G starting from vertex b in DFS.

   (iv) Write the tree edges, back edges, forward edges, and cross edges.

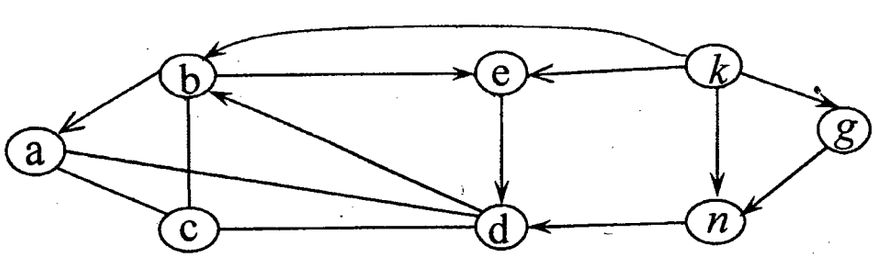


Figure for Question 3(b)

Contd P/2

CSE 203

4. (a) What is a tree? Write a linear-time algorithm for finding the height of a tree. Analyze the time-complexity of the algorithm. **(1+4+4=9)**

(b) Let T be a proper binary tree with height h. Then, prove that the number of internal nodes in T is at least h and at most $2^h - 1$. **(4+4=8)**

(c) Construct the binary tree whose inorder and postorder traversals are given as: **(10)**

Inorder : *i f d j g c a b k h m e*

Postorder : *i j g d f k m h e b a c*

(d) Draw the Linked Structure for the binary tree of Question 4(c). **(8)**

SECTION – B

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

5. (a) Sort the following dataset using "quicksort" in descending order when pivot element is the first element. **(12)**

$D = \{6, 0, 2, 0, 1, 3, 6, 1\}$

(show the steps)

(b) If you use "merge-sort", what will be the merge-tree for the data set mentioned in Q. 5(a)? Show that merge sort runs in time θ (*nlgn*) in the wrost-case. **(6+4=10)**

(c) Analyze the average case running time for "bucket sort". **(8)**

(d) Write the "counting sort" steps for the dataset of Q. 5(a). **(5)**

6. (a) Write pseudo-code for finding a key, inserting a key and deleting a key in a hash table using quadratic probing. Explain your method with an example. **(12)**

(b) Prove that in a hash table in which collisions are resolved by "chaining", a successful search takes average case time $\theta(1+\alpha)$, under the assumption of uniform hashing, where α is the load factor. **(10)**

(c) Insert key in a hashtable of size 13 using double hashing with **(13)**

$h_1(k) = k$ mod hash-table size

and $h_2(k) = 8 - (k \text{ mat } 8)$,

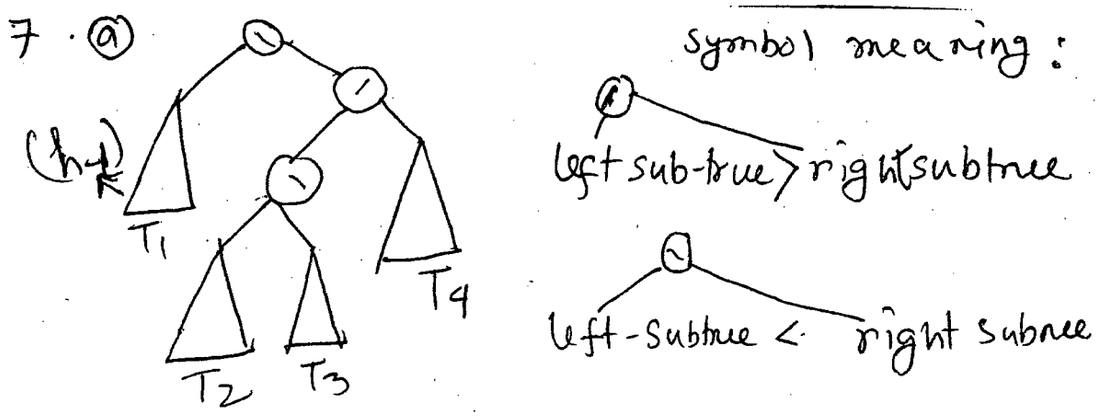
where k is the key, h_1 and h_2 are hash functions. Key insertion order is–

18, 41, 22, 44, 59, 32, 31, 73.

Contd P/3

CSE 203

7. (a) **(4+4+7=15)**



If T_1 has height h-1, what will be the heights of T_2, T_3, and T_4? What will happen if you delete an element from T_1? Discuss different cases (all possible) for deletion operation in an "AVL tree".

(b) Design an AVL tree with keys 5, 12, 3, –2, –5, –3, 1. Show the steps. **(15)**

(c) What is the height for AVL tree? (Assume that the number of internal nodes of the AVL tree is *n*.) **(5)**

8. (a) Write down the properties of a "red-black tree". With an example show insertion and deletion operations and their costs of a "red-black" tree. **(5+15=20)**

(b) Build "2-3-4 tree" with the keys 12, 5, 6, 10, 15, 8, 13, 17, 11, 14, 4. Delete elements in the following sequence: 4, 12, 13. (show the steps). **(15)**

L-2/T-1/CSE **Date : 26/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2012-2013

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**.

1. An n-p-n transistor is biased as shown in Fig. for Q. No. 1(a). Its $I_C - V_{CB}$ characteristic graph is drawn in Fig. for Q. No. 1(b). To find out the value of V_{CB} at bias point, we need to draw another plot of $I_C - V_{CB}$ involving 2 KΩ resistance connected to collector terminal over the $I_C - V_{CB}$ characteristic graph and determine the intersection point.

   (a) Express the collector current I_C as a function of V_{CB} that involves 2 KΩ resistance (it would be a straight line equation). **(16)**

   (b) Find out the mathematical equation describing $I_C - V_{CB}$ characteristic graph of BJT (it will be a piecewise linear graph). **(10)**

   (c) Draw these two $I_C - V_{CB}$ graphs over the same plot exactly to the scale and determine their intersection point. (This intersection point will tell you the value of I_C and V_{CB} at bias point.) **(10)**

   (d) From the value of V_{CB}, can you tell the value of V_{CE} at bias point? **(10⅔)**

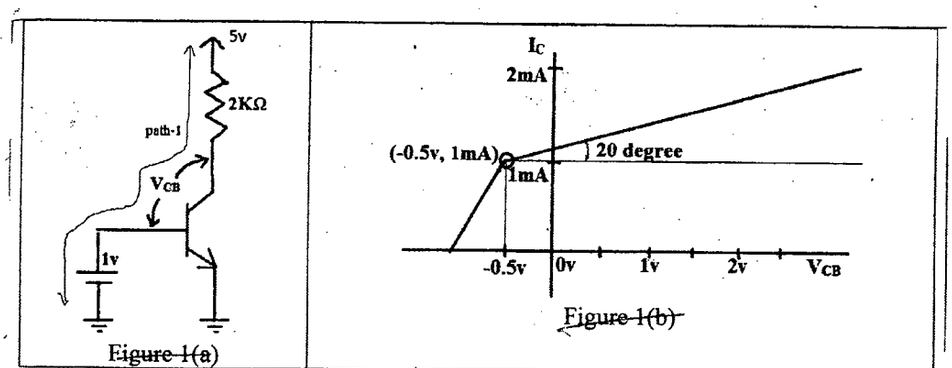


Figure 1(a) Figure 1(b)

Fig. for Q. No. 1(a) Fig. for Q. No. 1(b)

2. (a) Fig. for Q. No. 2(a) is the basic structure of a trans-conductance amplifier. It is to be implemented by a BJT. **(20)**

   Given, $Av_{in} = I_C R_{out}$, along with the fact that $R_{sig} \rightarrow 0$, and the load (R_L) of the amplifier can be much greater than R_{out}; which one of the three BJT circuit configurations (common emitter, common base, common collector) will you choose for best performance? Explain why. Comment on its gain and loading effect.

Contd P/2

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Contd... Q. No. 2

(b) Graphically explain the benefit of having $R_E>0$ in the biasing scheme of Fig. for Q. No. 2(b). **(16)**

(c) Make a NAND and a NOR gate using BJTs. **(10⅔)**

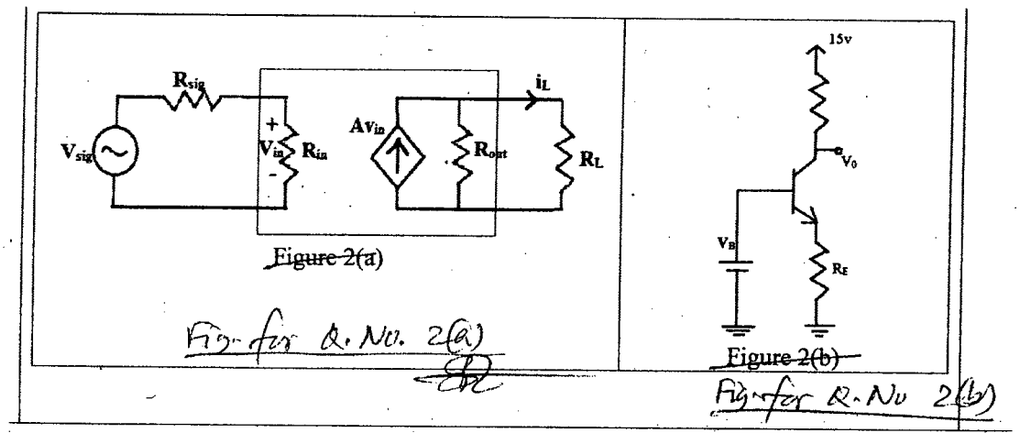

Figure 2(a)

Fig. for Q. No. 2(a)

Figure 2(b)

Fig. for Q. No 2(b)

3. (a) Why do we need to bias a BJT at a proper Q-point before using it as an amplifier? **(5)**

(b) Fig. for Q. No. 3(a) is an inverter gate built by an npn BJT and Fig. for Q. No. 3(b) is its output (V_0) voltage Vs. Base-Emitter voltage (V_{in}) characteristics. Copy figure 3(b) to your answer script exactly to the scale and then draw collector current (I_C) of BJT versus input voltage (V_{in}) over the same graph. **(16)**

See how the co-ordinates of the bending points of $V_0 - V_{in}$ graph is mentioned in Fig. for Q. No. 3(b). Likewise, mention the co-ordinates of the bending points of $I_C - V_{in}$ graph you have drawn.

(c) Modify both the $V_0 - V_{in}$ and $I_C - V_{in}$ graph if R_C is infinity. **(10)**

(d) Modify both the $V_0 - V_{in}$ and $I_C - V_{in}$ graph if supply voltage is increased from 5V to 10V. ($R_C = 480\ \Omega$) **(10⅔)**

(e) If the BJT in active mode shows a linear $I_C - V_{BE}$ behavior instead of exponential one, does voltage gain change with change in bias voltage V_{in}? Does output voltage swing change with the change in V_{in}? Explain why. **(5)**

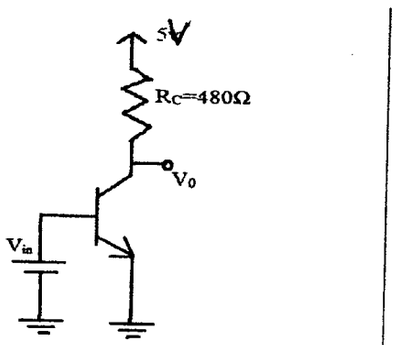

Fig. for Q. No. 3(a)

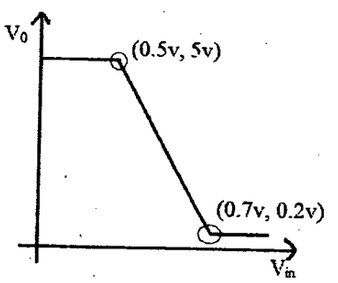

Fig. for Q. No. 3(b)

Contd P/3

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4. (a) An AC voltage source is applied to a series combination of a diode and a resistance. The dotted line in figure 4 is the input voltage waveform (V_{ac}), and the solid line is the output voltage waveform (V_R) across the resistance. Copy V_R of figure 4 (the solid line) to your answer script exactly to the scale and draw the voltage waveform across the diode over the same graph. Given that, $\frac{dV_{ac}}{dt} = 1$ V/sec when V_{ac} is rising and $\frac{dV_{ac}}{dt} = -1$ V/sec when V_{ac} is falling. **(20)**

(b) Draw I-V characteristics curve of the above diode exactly to the scale (i.e.- mention the voltage(s) at which diode begins conduction) **(16)**

(c) Draw the voltage waveform across the diode if it would have been connected in parallel to the resistance. **(10⅔)**

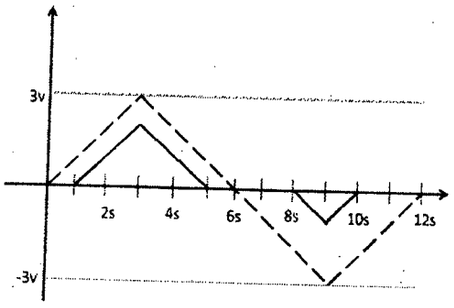

Fig. for Q. No. 4

SECTION – B

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

5. (a) What are the mutual advantages and disadvantages of BJT and MOSFET? **(12)**

(b) Explain the concept of threshold voltage (V_t) of a MOSFET. What happens to V_t and oxide capacitance (C_{ox}) if **(20⅔)**

(i) the dielectric thickness is increased/decreased?

(ii) the gate insulator is replaced with a more high-k dielectric of same thickness?

(c) The NMOS transistors in the circuit of the Fig. for Q. No. 5(c) have V_t = 1 V, $\mu_n C_{ox} = 120\ \mu A/V^2$, and $L_1 = L_2 = L_3 = 1$ μm. Find the required values of gate width for each of Q_1, Q_2, and Q_3 to obtain the voltage and current values as indicated in the figure. **(14)**

Contd P/4

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Contd... Q. No. 5(c)

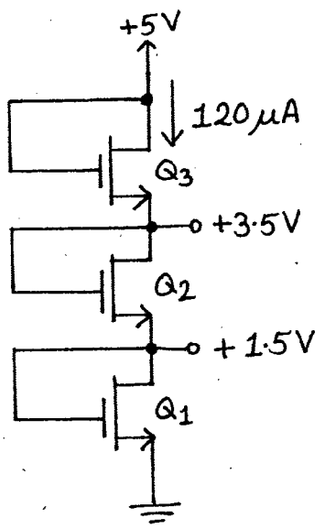

Fig. for Q. 5(c)

6. (a) For CS amplifier, derive the expression for input resistance (R_{in}), output resistance (R_{out}), open-circuit voltage gain (A_{vo}), overall voltage gain (G_v). **(26⅔)**

(b) Explain graphically the benefit of using a resistance at MOSFET source terminal. How does it fight with the problem of unpredictable variation in process parameter such as V_t, C_{ox}, μn; where the symbols have their usual meanings. **(20)**

7. (a) Draw the voltage transfer characteristic of a MOSFET. In which part of this graph, a MOSFET is used as an amplifier and why? What are the benefits and drawbacks of increasing bias voltage? **(19⅔)**

(b) Explain graphically why in a closed loop feedback circuit of OPAMP, differential voltage E_d is taken as zero. **(12)**

(c) Draw a zero crossing detector circuit using OPAMP and briefly describe its operation. **(15)**

8. (a) Draw a Wien Bridge oscillator circuit and describe its operating principle. **(17)**

(b) Design an OPAMP circuit that will perform the following mathematical operation: **(16)**

$$v_{out} = 5v_1 - 2\frac{dv_2}{dt} + 6\int v_3 dt$$

where v_1, v_2 and v_3 are three input signals and v_{out} is the overall output signal.

(c) Derive the closed loop gain of an inverting OPAMP amplifier as a function of its open loop gain, provided that the open loop gain is not infinity. **(13⅓)**

Extra

L-2/T-1/CSE **Date : 02/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2012-2013

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 have their usual meaning.

SECTION – A

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

1. (a) Prove the following triangle inequalities of complex numbers **(17)**

(i) $|z_1+z_2|\le|z_1|+|z_2|$ (ii) $|z_1-z_2|\ge\|z_1|-|z_2\|$.

(b) Find all the roots of the following equations in rectangular coordinates, exhibit them geometrically, and point out which is the principal root. **(18)**

(i) $z^4+2\sqrt{3}+2i=0$; (ii) $z^3+1-i=0$

2. (a) Define analytic function and harmonic function. Show that $u(x,y)=3x^2y+2x^2-y^3-2y^2$ is harmonic in some domain and find its harmonic conjugate $v(x,y)$. Express $f(z)=u+iv$ in terms of z. **(17)**

(b) Evaluate $\int_C \bar{z}dz$ from $z = 0$ to $z = 4 + 2i$ along the curve C given by (i) $z=t^2+it$;

(ii) the line from $z = 0$ to $z = 2i$ and then from $z = 2i$ to $z = 4 + 2i$. **(18)**

3. (a) (i) If $f(z)$ is integrable along a curve C having finite length L and if there exists a positive number M such that $|f(x)|\le M$ on C, then show that $\left|\int_c f(z)dz\right|\le ML$. **(13)**

(ii) Use the above result to show that $\left|\int_c \frac{dz}{z^2-1}\right|\le\frac{\pi}{3}$, where C is the contour $|z|=2$ in the first quadrant. **(5)**

(b) Use Cauchy's Integral formula to evaluate $\int_C \frac{\cos z}{z\left(z^2+8\right)}dz$; where C is the boundary of the square defined by the lines $x=\pm2$, described in the positive sense. **(17)**

4. (a) Determine the poles of $f(z)=\frac{e^z}{\left(z^2+\pi^2\right)^2}$ and find residues at each pole then use residue theorem to evaluate $\oint_C \frac{e^z}{\left(z^2+\pi^2\right)^2}dz$ where C is the circle $|z|=4$. **(18)**

(b) Find a bilinear transformation which maps the upper half of the z plane into the unit circle in the w plane in such a way that $z = i$ mapped in to $w = 0$ while the point at infinity mapped into $w = -1$. **(17)**

SECTION – B

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

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

(a) $\int_0^{2\pi}\frac{\cos2\theta}{5+4\cos\theta}d\theta$ (b) $\int_{-\infty}^{\infty}\frac{x^2}{\left(x^2+1\right)^2}dx$

Contd P/2

MATH 241/CSE

6. (a) Following are the runs obtained by two players A and B in 10 matches: **(15)**

Runs scored by A:	55	80	78	49	52	76	78	76	62	76
Runs scored by B:	54	78	55	66	63	69	74	64	59	85

Compute:

(i) Pearson's coefficient of skewness and kurtosis and Bowley's coefficient of skewness and comment on the shape of the runs scored by B only.

(ii) If the consistency of performance is the criterion for awarding a prize, who should get the prize?

(b) In testing a certain kind of truck tire over a rugged terrain, it is found that 20% of the trucks fail to complete the test run without a blowout. Of the next 18 trucks tested, find the probability using (both binomial and Posisson distribution) that **(10)**

(i) from 4 to 7 have blowouts;

(ii) fewer than 3 have blowouts;

(iii) more than 5 have blowouts.

(c) Derive the mean and variance of the frequency function for the binomial distribution. **(10)**

7. (a) Calculate two regression equations and regression coefficients from the data given below: **(18)**

Marks in Economics (Out of 50):	47	38	34	44	32	41	35	32	42	30
Marks in Business (Out of 50) :	38	34	42	39	34	33	30	41	38	28

Estimate the marks in economics if a student has scored 36 in business and the mark in business if another student has scored 44 in economics. Also comment on the correlation of the above mentioned marks obtained in economics and business.

(b) A survey of 640 families with 5 children each revealed the following distribution: **(17)**

No. of boys:	5	4	3	2	1	0
No. of girls:	0	1	2	3	4	5
No. of families:	28	112	220	176	80	24

Is this result consistent with the hypothesis that male and female births are equally probable? (use a 5% level of significance, given that for $\nu = 5$, $\chi^2_{0.005} = 11.07$)

8. (a) For the joint density function **(18)**

$$\begin{cases} \dfrac{6-x-y}{3}, & 0 < x < 2,\ 2 < y < 4 \\ 0, & \text{elsewhere,} \end{cases}$$

Find $P(1 < Y < 3 \mid x = 2)$.

(b) In a survey of buying habits, 500 women shoppers are chosen at random in **super market *A***. Their average weekly food expenditure is Tk. 500 with a standard deviation of Tk. 80. For another group of 500 women shoppers chosen at random in **super market B** located in another area of the same city, the average weekly food expenditure is Tk. 440 with a standard deviation of Tk. 90. Test at 10% level of significance whether the average weekly food expenditures of the populations of women shoppers are equal. **(17)**

L-2/T-1/CSE **Date : 19/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2012-2013

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) Derive the state diagram from the following sequential circuit. **(15)**

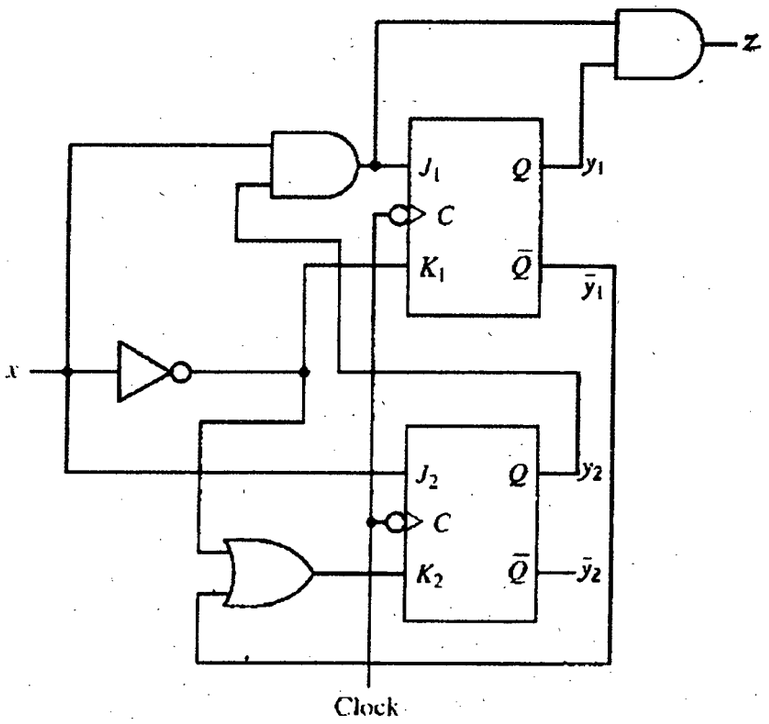

Figure for question 1(a)

(b) Explain the undefined condition in SR flip-flops. How is this problem solved in JK flip-flops? **(4+4=8)**

(c) Explain how Ripple-blanking input (RBI) and Ripple-blanking output (RBO) pins of the BCD to 7-segment decoder (IC 7447) should be connected such that all but the LSB should show blank for leading zeros. **(6)**

(d) What are the advantages and disadvantages of using Mealy Model and Moore Model for sequential circuit design? **(6)**

2. (a) Design a synchronous counter with the following binary sequence 0, 1, 3, 7, 6, 4 and repeat. Use T flip-flops. **(15)**

(b) Draw the state diagram in Moore model of a synchronous sequential circuit that results in an output of 1 whenever the sequence 10011 occurs. The circuit is required to recognize overlapping sequence. **(8)**

(c) Draw the logic diagram of a serial adder. Show the values of inputs and outputs of all the registers used in your design after every clock pulse while adding the following two numbers 0101 and 0011. **(8+4=12)**

Contd P/2

CSE 205

3. (a) (i) Design a modulo-6 3-bit Asynchronous (ripple) up counter with positive edge triggered JK flip-flops. **(8+4+3=15)**

(ii) Show the Timing diagram for the above designed counter.

(iii) What are the problems of the above counter?

(b) Draw the circuit diagram of a 4-bit universal shift register using JK flip-flops. **(12)**

(c) Convert a T flip-flop into a JK flip-flop and vice versa. **(4+4=8)**

4. (a) Using an implication table, reduce the following state table to a minimum number of states and write the reduced state table. **(17)**

	X	
	0	**1**
A	E/0	D/0
B	A/1	F/0
C	C/0	A/1
D	B/0	A/0
E	D/1	C/0
F	C/0	D/1
G	H/1	G/1
H	C/1	B/1

(b) Minimize the following function in both SOP and POS forms using Karnaugh map. **(12)**

$$f(A,B,C,D)=\sum m(0,4,7,9,13)+d(5,8,15)$$

(c) What are the problems that may occur when redundant states are present in the state diagram? **(6)**

SECTION – B

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

5. (a) State and prove De Morgan's theorem using truth table. **(10)**

(b) Given the Boolean function $F = xy + x'y' + y'z$, implement it with (i) AND, OR and NOT gates, (ii) only NAND gates. **(5+5=10)**

(c) (i) What are the differences between canonical form and standard form? **(8+4+3=15)**

(ii) Which form is preferable when implementing a Boolean function with gates? Why?

(iii) Which form is obtained when reading a function from a truth table?

Contd P/3

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6. (a) Implement $F = \sum(3, 5, 7, 10, 11, 13, 14, 15)$ using 16-to-1 MUX. **(10)**

   (b) Can the function in 6(a) be implemented by using only one 4-to-1 MUX? If yes, show how; if not, explain why. **(10)**

   (c) You need a full adder for an experiment. But in lab you could not find a full adder, instead you found plenty of 3-to-8 decoders. Can any such decoder be used as a full adder? Explain your answer with truth table. **(15)**

7. (a) Starting with truth table, design a full subtractor. **(20)**

   (b) Using 2's complement, subtract decimal –70 from decimal –50. **(9)**

   (c) Perform the following binary subtraction: **(6)**

   $$11000011 - 10101010$$

8. (a) You are receiving BCD codes sent by a remote transmitter. The bits are $A_3A_2A_1A_0$; A_0 being the LSB. You intend to include a BED (BCD-error-detector) in your receiver that examines the received codes to see if it is a legal BCD code. Design a BED for your receiver that will produce a HIGH for any received code that is not a valid BCD code. For example, if you receive 1010, the output of BED will be high. **(15)**

   (b) The figure below represents a multiplier that takes two 2-bit binary numbers x_1x_0 and y_1y_0 as inputs, and produces an output binary number $p_3p_2p_1p_0$ that is equal to the arithmetic product of the two input numbers. Design the logic circuit for the multiplier. **(20)**