University of Dhaka

Department of Computer Science and Engineering

B.Sc. 2nd Year 1st Semester-2014

Second Incourse Exam

Course Name: Ordinary Differential Equation Course Code: MTM-2121

Total Marks: 30 Time: 1 Hour

Answer all the questions.

1. Consider the differential equation $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$. Show that e^{2x} and e^{3x} are two solutions of the equation. Check whether these solutions are linearly independent or not. If they are linearly independent then write the general solution. Find the solution that satisfies the condition $y(0) = 2, y'(0) = 3$. 7

2. The roots of the auxiliary equation, corresponding to certain 8th order homogeneous linear differential equation with constant coefficients, are 0, 0, 4, 4, 2+3i, 2-3i, 2+3i, 2-3i. Write the general solution. 4

3. Consider the differential equation $\frac{d^4y}{dx^4} + \frac{d^2y}{dx^2} = 3x^2 + 4\sin x - 2\cos x$. Find the complementary function of the given equation. Formulate y_p, the particular integral using the method of undetermined coefficients. DO NOT ATTEMPT TO FIND THE SOLUTION OF THE EQUATION. 7

4. What are the advantages of the method of variation of parameters over the method of undetermined coefficients? Find the general solution of the following differential equation using variation of parameters: $\frac{d^2y}{dx^2} + y = \tan x$. 12

University of Dhaka
Department of Computer Science and Engineering
B.Sc. 2nd Year 1st Semester-2014
First Incourse Exam
Course Name: Ordinary Differential Equation Course Code: MTM-2121
Total Marks: 30 Time: 1 Hour

Answer all the questions.

1. Define order and degree of an ordinary differential equation? State the order and degree of the following differential equations mentioning the reasons. Also determine whether the equation under consideration is linear or nonlinear (in y). 10

   i) $x\frac{d^3y}{dx^3} - (\frac{dy}{dx})^4 + y = 0$ ii) $\frac{d^3y}{dx^3} = \sqrt{1 + (\frac{dy}{dx})^2}$

   iii) $x^2dy + y^2dx = 0$

2. What is the role of integrating factor in a differential equation? Find the integrating factor of the differential equation: $(x^2 - 2y)dx - xdy = 0$. Hence, solve the equation. 5

3. What is the necessary and sufficient condition for an ordinary differential equation to be exact? Determine the most general function $M(x, y)$ such that the following equation is exact: $M(x, y)dx + (2x^2y^3 + x^4y)dy = 0$. 5

4. Solve the following differential equations using any suitable method: 10

   i) $\frac{dy}{dx} + \frac{y}{2x} = \frac{x}{y^3}$, $y(1) = 2$.

   ii) $(x^2 - 3y^2)dx + 2xydy = 0$.

Incourse 2

CSE 2111: Data Structures

Duration: 1 hour **Full Marks: 30**

1. How do you represent binary search tree in memory? Why? Mention the advantages of binary search tree. 4
2. Write down a recursive procedure to count the number of nodes in a given binary search tree. 5
3. In case of deleting a node having two children, Why do you need to find inorder successor or inorder predecessor? How do you find them? 3
4. Suppose the following sequences list the nodes of a binary tree T in preorder and inorder, repectively. 6

   Preorder: G, B, Q, A, C, K, F, P, D, E, R, H

   Inorder: Q, B, K, C, F, A, G, P, E, D, H, R

   Draw the tree.
5. How do you represent heap in memory? Why? How do you preserve parent child relation in your representation? 3
6. Build a max heap with the following numbers and show the intermediate stages. 5

   44, 30, 50, 22, 60, 55, 77, 77
7. Suppose the six weights 4, 15, 25, 5, 8, 16 are given. Find a 2-tree with the given weights having minimum weighted path length. 5

University of Dhaka
Department of Computer Science & Engineering
CSE 2102: Object oriented Programming (2nd Incourse Examination)

Total Marks: 35 **Total Time: 1 Hour 10 minutes**

1. Write a program that will read a number at a time from the keyboard and check whether this number belong to an existing list. If not, your program should include that number into the list; otherwise generate an exception that will display "REDUNDANT INPUT" on the screen and prompt another input. Your program will terminate when you enter a negative number. Finally, your program should display the list. Design your exception class and write appropriate code. 8

Sample Output:
Enter number: 11
Enter number: 85
Enter number: 26
Enter number: 11
REDUNDANT INPUT
Enter number: 41
Enter number: -1
11 85 26 41

2. Write a Java Program with the following properties: 10
   (1) Package **A**:
      (a) An interface ***manage_list*** contains an abstract method void ***sort()***.
      (b) Class ***list*** contains two data members **a[]** (array of integer) and **b[]** (array of String) accessible only by the subclasses. This class should contain a ***toString()*** method.
      (c) Class ***num_list*** is a subclass of ***list*** and implements ***manage_list.*** This class arranges the element of **a[]** in ascending order and prints the sorted list using ***toString()*** method.
   (2) Package **B**:
      (a) Class ***name_list*** is a subclass of ***list*** and implements ***manage_list.*** This class arranges the element of **b[]** in alphabetic order and prints the sorted list using ***toString()*** method.
   (3)Package **C**:
      (a) Class ***test*** contains ***main()*** method to access all the above mentioned classes as well as the methods.

   You should mention the name of each file with **.java** extension.

3. What are the advantages of using an interface? 3

4. Discuss the use of keyword ***super*** using simple example. 4

2. Consider the following code segment:

```
public interface Red{
        public void turnRed();
}
public interface Blue{
        public void turnBlue();
}

public class A implements Red {
    public void one() {
            System.out.println( "A.1" );
    }
    public void two(){
            one();
            System.out.println( "A.2" );
    }
    public void turnRed() {
        System.out.println("Nooooo!!");
    }
}
```

```
public class B extends A implements Red,
Blue {
    public void one( int x){
        System.out.println( "B.1 " + x );
    }
    public void two() {
        System.out.println( "B.2" );
    }
    public void turnBlue() {
        System.out.println("Aaiiee!!");
    }
public class C extends A {
    public void one() {
        System.out.println( "C.1" );
    }
}
```

For each of the following, determine the output when the code will be executed. If some sort of errors are generated, give a brief explanation of the problem.

(a) `A a = new B();`
`a.two();`
	(b) `B b = new B();`
	`b.one(4);`
	`b.one();`
		(c) `Red r = new B();`
		`r.turnRed();`	

(d) `Blue b = new Blue();` `b.turnBlue();`	(e) `C c = new A();` `c.two();`	(f) `A a = new B();` `a.turnBlue() ;`	(g) `A a = new C();` `a.two();`

University of Dhaka
Department of Computer Science and Engineering
Course Code: CSE 2102 Course Title: Object Oriented Programming

Total Mark: 40 **Total Time: 1 Hour 10 minutes**

1. Explain how Java ensures portability of a program. 4

2. Write a java program that will contain a class **Operate_String**. This class should contain the following features: 10
   - (i) A private data member **Name** of type String.
   - (ii) A constructor with empty parameter list.
   - (iii) A constructor that will take a String as a parameter.
   - (iv) A constructor that will take an array of characters as parameter.
   - (v) The class will contain two overloaded methods named **add_info ()**. One version of **add_info ()** will concatenate two String data and other version will produce information about a person with Name, age and salary by concatenation operation.
   - (vi) Design your **main ()** method to access all the methods of **Operate_String** class.

3. Consider the following program. Identify errors and explain the reasons. 8

```
class Temp
{
    int a;
    static int b;
    Temp(int i, int j)
    {
        a=i;
        b=j;
    }
    int add_num()
    {  return a+b;}

    static int meth()
    {
        return a+add_num();
    }
}

class Temp_Main{
    public static void main(String args[])
    {
        Temp.a=100;
        int k=Temp.meth();
        Temp ob=new Temp(3,4);
        System.out.println(ob.b);
    }
}
```

4. Write a public method ***void shuffle (String word)***. This method will divide the string ***word*** into two halves and will generate a new string by taking one character at a time alternatively from each halves. For example if ***word*** is ABCDEFGHI then ***shuffle (String word)*** will work in the following manner: 5
   ABCDEFGHI → ABCD EFGHI → AEBFCGDHI

5. Consider the following statements: 3
   int a[];
   int b[] = null;
   int c[] = new int[5];
   int d[] = { 1, 2, 3, 4, 5 };
   a = c;
   d = c;
   For each of the statements show the memory allocation.

6. Consider the following java program. Generate output and explain your output: 10

```
class grandparent
{
    private float f;
```

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Course Code: CSE 2102 Course Title: Object Oriented Programming

Total Mark: 40 **Total Time: 1 Hour 10 minutes**

```
    grandparent(float m)
    {
        f=m;
    }
     void setf(float k) {f=k;}
     float getf() {return f;}

    void show() {System.out.print("f : "+f);}
}
class parent extends grandparent
{
    private int a;
    parent(float f, int t)
    {
       super(f);
       a=t;
    }
    void seta(int k) {a=k;}
     int geta() {return a;}

    void show(String msg) {System.out.println(msg +a+" "+getf());}
    void show() {super. show( );    System.out.println(" "+a);}
}
class child extends parent
{
    private String str;
    child(float f, int p, String s)
    {
        super(f, p);
        str=s;
    }
    child(child o){
    super(o.getf(), o.geta());
    str=o.str;
    }
}
class test
{
   public static void main(String args[])
   {
       child c= new child(2.34f, 56, "TEST");
       child c1=new child(c);
       c1. show();

       parent p=new parent(3.45f, 95);
       p.show(" output: ");
       p.show();

       grandparent gp=new grandparent(34.98f);
       gp.show();

       gp=p;
       gp.show();
       gp=c1;
       gp.show();
   }
}
```

1. f: 2.34
2. 56
3. output: 95
4. f: 3.45
5. 95
6. f: 34.98
7. f: 3.45
8. f: 2.34

Department of Computer Science and Engineering
Midterm Examination
STAT 2122: Introduction to Probability

Time – 1 hour

Full Marks – 35

Answer all the questions.

1. Two dice are thrown. Write down the elements of the event that the second die shows a number greater than four.

2. Write down all the different permutations of the letters in the word "WEEK".

3. Three coins are tossed. What is the probability that at least one of the coins fall heads?

4. To go to office from home, Mr. Smith takes either Route A (with probability 0.8) or Route B (with probability 0.2). If he takes Route A, he is in a traffic jam with probability 0.3. For Route B this probability is 0.8.
   (a) What is the probability that Mr. Smith will be in a traffic jam on a particular day?
   (b) If he is in a traffic jam, what is the probability that he took Route A?

5. For an unfair die, $P(x) = \frac{x}{21}$; $x = 1, 2, 3, 4, 5, 6$. If you toss the die twice, what is the probability that you will get a '3' on the first toss and a '6' on the second toss.

6. The density of X is given below. Find $P(X < 0)$.

$$f(x) = \frac{3}{4}(1 - x^2), \qquad -1 < x < 1.$$

7. Events A and B are equally likely and independent. If $P(A \cup B) = 0.75$, find $P(A)$.

The End

University of Dhaka

Department of Computer Science and Engineering

CSE 2101: Data Structures

Full Marks: 30 **Duration: 1hr**

1. An array A contains 25 positive integers. Write a module which finds all pairs of elements whose sum is 25. 5

2. Discuss the advantages, if any, of a two-way linked list over a one-way linked list for each of the following operations. 5

   i) Traversing the list to process each node
   ii) Deleting a node whose location LOC is given
   iii) Searching an unsorted list for a given element ITEM
   iv) Inserting a node before the node with a given location LOC

3. Write down a procedure which removes the first element of a linked list and adds it to the end of the list without changing any values in INFO. 5

4. Write down a pseudo code to transform an infix expression into a postfix expression. 5

5. Consider the following queue where QUEUE is allocated 6 memory cells. 5

   FRONT=2, REAR=5, QUEUE: _____, London, Berlin, Rome, Paris, _____

   Describe the queue, including FRONT and REAR, as the following operations take place: i) Athens is added, ii) two cities are deleted and iii) Madrid is added.

6. Write a procedure to insert an item in a Queue which is implemented by Linked list. Specify the assumptions if necessary. 5

Department of Computer Science & Engineering
University of Dhaka
Incourse - 1
CSE – 2103 Computer Architecture
Marks – 30 Time – 1 hr

Attempt all questions:

1. a) What are the limitations of accumulator-based CPU? 2
   b) Suppose you wish to run a program P with 7.5×10^9 instructions on a 5 GHz machine with a CPI of 0.8. What is the expected CPU time? 3
   c) Write -2.75 in IEEE 754 64-bit floating point number representation. 3
   d) What is Register Indirect Addressing? 2
   e) Convert the following code into equivalent ARM instructions: 5

```
while (A[i] == j)
 { i = i + 10;
   x = x * 5;
}
y = y + x;
```

Assume that i, j, x and y correspond to registers r3, r4, r5 and r6 and the base of the array A is in r7.

2. a) What is the equivalent zero-address machine code of **(A+B-C)/(A*B-C)** 3
   b) Draw the circuit of a 4-bit serial adder using J-K FF. 4
   c) Consider a stack (Motorola 680X0) where 5
   A2 = stack pointer register = 0AAAAAAA
   D6 = stack data register = B(2,3)B(2,2)B(2,1)B(2,0)
   Assume that the stack contains some data inside it.

   Draw the stack before and after the execution of the following instructions:
   MOVE.L D6, -(A2)
   MOVE.L D6, -(A2)

   What will be the content of D6 and A2 at this stage?
   d) Explain how to determine if a number is negative in the following representations: 3
      i) Sign-magnitude
      ii) Two's complement

Department of Computer Science & Engineering
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Incourse - 2
CSE – 2103 Computer Architecture
Marks – 30 Time – 1 hr

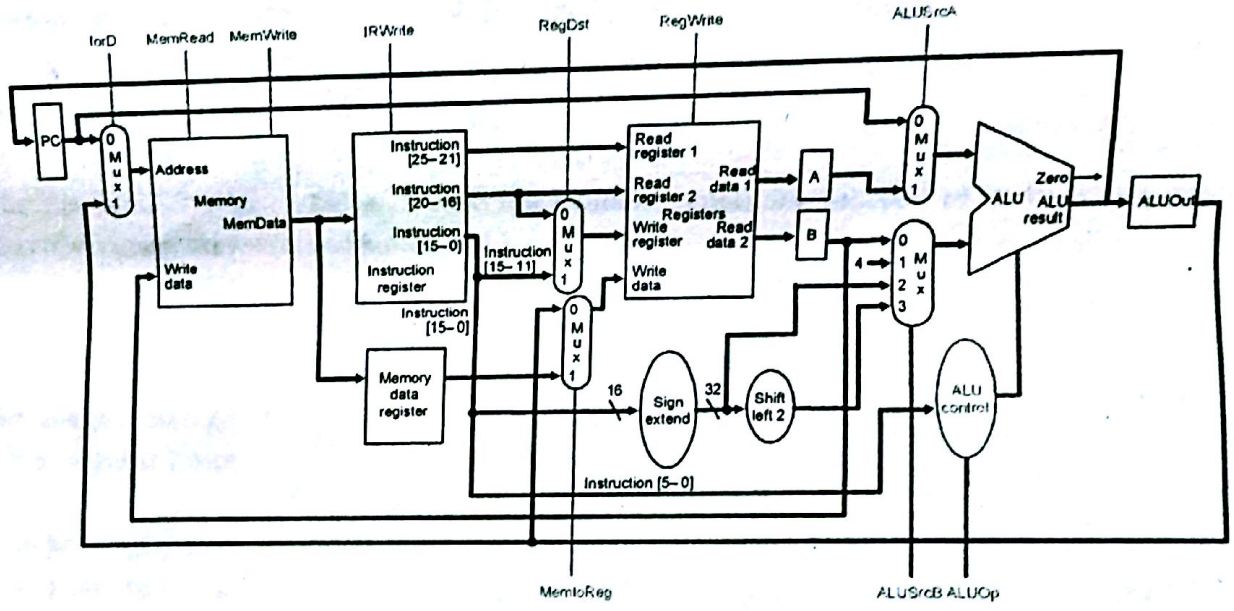
Attempt all questions:

1. What is a systolic array? What is the purpose of using systolic array in two-dimensional matrix multiplication? 4
2. What is MEM/WB hazard? Write an algorithm to detect MEM/WB hazard. 5
3. Write down the steps needed to calculate $Z = X \times Y$ using Booth's multiplication algorithm. Where, $X = 11010_2$ and $Y = 00101_2$. 6
4. What are the advantages of multi-cycle datapath over single-cycle datapath? 3
5. Consider the following code fragment being executed in the classical 5-stage pipeline: 5

```
lw $1, 0($0)
lw $2, 4($0)
add $3, $1, $2
sw $3, 12($0)
lw $4, 8($1)
add $5, $1, $4
sw $5, 16($0)
```

Find if there is any hazard and reorder the instructions to avoid any pipeline stalls. 7

6. Consider the following datapath of a multi-cycle processor:



Consider the instruction ***add $4, $5, $6***. Write down the actions carried out and the generated control signals in each cycle of the datapath.

Department of Computer Science and Engineering
Midterm Examination
STAT 2122: Introduction to Probability

Time – 1 hour

Full Marks – 35

Answer all the questions.

1. The distribution function of X is given below. Calculate $P(X \leq 5)$.

$$F(x) = \begin{cases} 0 & x \leq 1 \\ \frac{x-1}{8} & 1 < x < 9 \\ 1 & x \geq 9 \end{cases}$$

2. The joint probability function of X and Y is given below. Find $P(X = 0 \mid Y = 2)$.

x \ y	1	2	3
-1	$\frac{1}{17}$	$\frac{3}{17}$	$\frac{2}{17}$
0	$\frac{3}{17}$	$\frac{4}{17}$	$\frac{1}{17}$
1	$\frac{1}{17}$	$\frac{1}{17}$	$\frac{1}{17}$

3. The joint density of X and Y is given below. Find the conditional density of Y given $X = 0.5$.

$$f(x,y) = \begin{cases} \frac{2}{3}(2x+y) & 0 < x < 1, \ 0 < y < 1 \\ 0 & \text{otherwise} \end{cases}$$

4. The density of X is given below. Obtain the moment generating function of X. Then find the mean, variance, skewness and kurtosis of X.

$$f(x) = \frac{1}{\sqrt{2\pi}} \exp(-x^2/2), \qquad -\infty < x < \infty.$$

5. The average number of misprints in one page of a book is 3. What is the probability that there will be at most 2 (not more than 2) misprints in the next page?

6. In an MCQ test, there were 10 questions each with 4 choices. Smith did not study for the test at all and selected all the answers randomly. The next day he met the teacher in the corridor and learnt that the minimum mark was 2 out of 10 (that is, the minimum number of correct answers was 2), but the teacher could not tell him how much he obtained. What is the probability that Smith gets 4 out of 10?

7. Lifetime of motherboards of a particular brand follows exponential distribution with average lifetime 4 years. What is the probability that the motherboard that you just bought will survive between 3 and 5 years?