

Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Computer Science & Engineering

Final Examination, 2023

Course No: CSE 305

Time: 03 (Three) hours

2nd year 1st semester

Course Title: Digital Logic Design

Full Marks: 60

N.B. : (i) Answer any three question from each PART

(ii) Use separate answer scripts for each PART

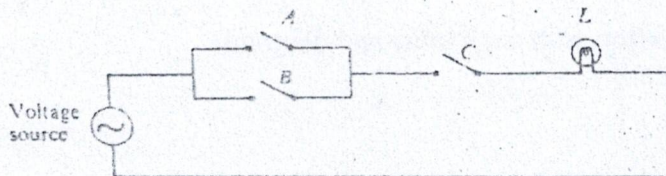
(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any three questions)

1. (a) Define Logic device with proper example. 04
- (b) What are the main differences between analog signal and digital signal? Mention the importance of digital signal. 04
- (c) What are the types of data transmission method? 02
2. (a) Find the 9's and 10's complement of the following decimal numbers: 1X4
 - i. 09900 ii. 90090
 - iii. 10000 iv. 13579
- (b) Perform the subtraction with the following binary numbers using (1) 2's complement and (2) 1's complement. Check the answer by straight subtraction. 1X4
 - i. 1101-1101 ii. 10010-10011
 - iii. 11010-10000 iv. 100-110000
- (c) Express the following switching circuit in binary logic notation. 02



3. (a) Complete the expressions: i) $A + 1 = \underline{\hspace{1cm}}$ ii) $D.1 = \underline{\hspace{1cm}}$ iii) $D + \bar{D} = \underline{\hspace{1cm}}$ iv) $y + \bar{w}y = \underline{\hspace{1cm}}$ 02
- (b) Express the Boolean function $F = xy + x'z$ in a product of maxterm form. 03
- (c) Simplify the following Boolean Functions to a minimum number of literals. 02
 - i. $x + x'y$
 - ii. $x'y'z + x'yz + xy'$
 - iii. $xy + x'z + yz$
 - iv. $x(x' + y)$
- (d) Find the complement of the functions $F_1 = x'yz' + x'y'z$ and $F_2 = x(y'z' + yz)$. Applying De Morgan's theorem as many times as necessary. 03
4. (a) What is Multiplexer? Implement $F(A,B,C) = \sum(1,3,5,6)$ with a multiplexer. 2+2
- (b) Design a circuit that compares two 4-bit numbers, A and B, to check if they are equal. The circuit has one output x, so that $x = 1$ if $A = B$, and $x = 0$ if $A \neq B$. 06

PART-B

(Answer any three questions)

5. (a) A combinational circuit has four inputs and one outputs. The output is equal to 1 when (1) all the inputs are equal to 1 or (2) none of the inputs are equal to 1 or (3) an odd number of inputs are equal to 1. 02
i. Obtain the truth table.
ii. Draw the two logic diagrams.
- (b) Implement a full-subtractor with two half subtractors and an OR gate. 04
- (c) Draw the logic diagram that converts a four-digit binary number to a decimal number in BCD. Note that two decimal digits are needed since the binary numbers range from 0 to 15 04
6. (a) What is Consensus Theorem? What are the conditions of Redundancy theorem? 1+1
- (b) Simplify each of the following functions and implement them with NAND gates. 2+2
i. $F_1 = AC' + ACE + ACE' + A'CD' + A'D'E'$
ii. $F_2 = (B' + D')(A' + C' + D)(A + B' + C' + D)(A' + B + C' + D')$
- (c) Find the sum of product expression using k-map for the following function where d represents don't care condition. $F(A, B, C, D) = \sum m(1, 4, 5, 6, 7, 9, 11) + d(13, 14)$. 04
7. (a) What is De-multiplexer? Explain the operation of a 1-to-8 De-multiplexer. 1+3
- (b) Illustrate decoder. Write down the equation and logic circuit for 8 to 3 encoders. 1+3
- (c) Write down the difference between combinational logic circuit and sequential logic circuit. 02
8. (a) Show the logic diagram of a clocked SR flip-flop with four NAND gate. 02
- (b) Define Flipflop. What are types of Flip Flop? 02
- (c) Briefly Explain T flip-flop by JK flip-flop with truth table and diagram. 06

Sylhet Engineering College, Sylhet
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Department of Computer Science & Engineering

Final Examination, 2023

Course No: STAT 301

Time: 03 (Three) hours

2nd Year 1st Semester

Course Title: Statics for Engineers

Full Marks: 60

N.B. : (i) Answer any three question from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any three questions)

1. (a) Define with examples: 1.5x2
i) Harmonic mean
ii) Deciles
- (b) Show that for two nonzero positive observations $AH = G^2$ where A is arithmetic mean, H is harmonic mean, and G is geometric mean. 03
- (c) Find out the 3rd quartile and 72th percentile from the following frequency distribution. 04

Class interval	11-15	16-20	21-25	26-30	31-35	36-40	41-45
Frequency	4	5	6	3	6	7	4

2. (a) Define variance. If $u = x + y$ then show that $Var(u) = Var(x) + Var(y) + 2Cov(x, y)$ 2+3
- (b) For a set of non-zero positive values $x_1, x_2, x_3, \dots, x_n$ prove that $A \geq G \geq H$, where A, G and H are respectively arithmetic mean, geometric mean and harmonic mean. 05
3. (a) Define mean deviation. Compute mean deviation of the following data from median and mode. 1.5+
4.5

Class interval	49-53	54-58	59-63	64-68	69-73	74-78	79-83	84-88	89-93	94-98
Frequency	2	2	3	5	5	5	5	7	10	6

- (b) Show that the standard deviation of first n natural is $\sqrt{\frac{n^2-1}{12}}$ 04
4. (a) Calculate standard deviation from the frequency distribution. 05

Class Interval	0	10	20	30	40	50	60	70	80
Frequency	150	140	100	80	80	70	30	14	0

- (b) Define central moments. Find the relations between first four central moments and raw moments. 05

PART-B

(Answer any three questions)

5. (a) Define with examples: i) experiment ii) trial iii) continuous random variable iv) probability density function. 1.5x4
- (b) A class is made up of 20 girls and 15 boys. It is decided to distribute 4 complementary tickets by lottery to 4 students of the class. What is the probability that
i) tickets go to four girls 04
ii) Tickets go to 2 boys and 2 girls.
6. (a) The probability function of a discrete random variable x is 05

$$f(x) = \begin{cases} k \left(\frac{3}{4}\right)^x, & x = 0, 1, 2, 3, \dots, \infty \\ 0, & \text{elsewhere} \end{cases}$$

Evaluate k and $P(x \leq 3)$.

- (b) The joint probability function of x and y is $P(x, y) = c(x + y)$; $x=1, 2, 3$; $y=1, 2$.
Find i) the value of c ii) the marginal probability function of x and y . ii) conditional probability function of x for given y and that of y for given x .

05

7. (a) A random variable x has the following probability density function $f(x) = cx(3-x)$; $0 \leq x \leq 3$
i) Determine c .
ii) Find the probability that $0 \leq x \leq 2$

05

- (b) Find the coefficient of correlation of the following data

X	9	8	7	6	5	4	3	2	1
Y	15	16	14	13	11	12	10	8	9

8. (a) Define binomial distribution. Four unbiased coins are tossed simultaneously. What is the probability of getting i) exactly two heads ii) at least three heads.
(b) Find the mean and variance for binomial distribution.

2+3

05

Sylhet Engineering College, Sylhet
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Department of Computer Science & Engineering

Final Examination, 2023

Course No: IPE 301

Time: 02 (Two) hours

2nd year 1st semester

Course Title: Management for Engineers

Full Marks: 40

N.B. : (i) Answer any two question from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any two questions)

- | | | |
|----|---|----|
| 1. | (a) Write down the characteristics of Scientific management and Bureaucratic management. | 02 |
| | (b) Note down basic features of learning organization and Total Quality Management (TQM) management approach. | 02 |
| | (c) Clarify your understanding about Management. 'Management is the attainment of organizational goals in an effective and efficient manner through planning, organizing, staffing, directing and controlling organizational resources.'-Justify the statement in context of management function. | 04 |
| | (d) What factors associated to change the management evolution? | 02 |
| 2. | (a) How 'Strategic plan' is different from 'operational plan'? Give with suitable examples of each. | 02 |
| | (b) Note down the steps of planning. Identify the principles for planning. | 04 |
| | (c) Discuss managerial role performed by a manager mention by MinzBerg. | 04 |
| 3. | (a) What are the objectives of organization? Differentiate between formal and informal Organization. | 03 |
| | (b) Discuss the techniques for effective coordination of an organization. | 04 |
| | (c) Briefly discuss the types of skills needed by a manager. | 03 |

PART-B

(Answer any two questions)

- | | | |
|----|--|----|
| 4. | (a) How Management by Objective (MBO) appraisal system is differing from 360 degree appraisal system? | 02 |
| | (b) Six workers completed a task in 07.30 hours, 07.80 hours, 07.90 hours, 06.79 hours, 08.60 hours and 09.50 hours respectively, though standard time for this task was 7.58 hours. If the hourly wage rate is 105.70 tk, how much the workers will get according to 50-50 Halsey plan and 70-30 Halsey plan? Which plan is more appropriate? | 04 |
| | (c) Illustrate an overview of recruitment process. | 04 |
| 5. | (a) Note down the steps of selection. | 02 |
| | (b) Shortly discuss the Herzberg's two factor theory of motivation. | 04 |
| | (c) Briefly discuss the analytical method of job evaluation with appropriate example. | 04 |
| 6. | (a) Identify the components of attitude. How attitude can be changed? | 03 |
| | (b) Discuss the Maslow's need hierarchy motivational theories. | 04 |
| | (c) What are the objectives of performance appraisal? | 03 |

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Sylhet Engineering College, Sylhet
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Department of Computer Science & Engineering

Final Examination, 2023

Course No: CSE 301

Time: 03 (Three) hours

2nd Year 1st Semester

Course Title: Object Oriented Programming Language

Full Marks: 60

N.B. : (i) Answer any three question from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any three questions)

1. (a) What is **Constructor**? 01
 (b) What is **JVM**? Why Java is called the "**Platform Independent Programming Language**"? 1+1
 (c) What is Garbage Collection? How does it work in Java? 1+2
 (d) How many Strings will be generated in the following code segment? What will be the output? 04
 Explain.

```

1) public class StringTest {
2)     public static void main(String args[]){
3)         String s1 = "Spring ";
4)         String s2 = s1 + "Summer";
5)         s1.concat("Fall"+"Winter");
6)         s2.concat(s1);
7)         s1 += "Winter";
8)         System.out.println(s1 + " " + s2);
9)     }
10) }
```
2. (a) Write the output of the following code segment: 03

```

class Animal {
    public void sound() {
        System.out.println("makes a sound."); } }
class Dog extends Animal {
    public void sound() {
        super.sound();
        System.out.println("The dog barks."); } }

class Cat extends Animal {
    public void sound() {
        super.sound();
        System.out.println("The cat meows."); } }
public class Main {
    public static void main(String[] args) {
        Dog dog = new Dog();
        Cat cat = new Cat();
        dog.sound();
        cat.sound(); } }
```
- (b) i) Write the output of the following code segment: 03

```

public class TestSubstring{
    public static void main(String args[]){
        String s="Sylhet Engineering College ";
        System.out.println(s.substring(6));
        System.out.println(s.substring(0,6));
    } }
```

 ii) Explain following methods:
 a) s2=s1.trim() b) s1.append(s2) c) p.indexOf('t',n)
- (c) Why we use **this** keyword in java? What will be output of the following program segment? 1+3

```

public class Student {
    int id;
    String name;
    Student(){
        System.out.println("default constructor");
    }
    Student(int i, String n){
        id = i;
        name = n; }
    public static void main(String[] args) {
        Student s = new Student();
        System.out.println("\nDefault Constructor: \n");
        System.out.println("Id:"+s.id+"\nName:"+s.name);
        System.out.println("\nParam Constructor: \n");
        Student student = new Student(10, "David");
        System.out.println("Student Id:"+student.id +
        "\nStudent Name : "+student.name); } }
```
3. (a) What will be the output of the following program? 03

```

class Demo implements Runnable{
    public void run(){
        for(int i=0;i<=10;i++){
            System.out.println("\nThread: "+i);}
        System.out.println("End of Thread"); } }

class Test{
    public static void main(String args[]){
        Demo obj=new Demo();
        Thread tobj =new Thread(obj);
        tobj.start();
        System.out.println("End of main Thread"); } }
```


- (b) What will be the output of the following program segment? 03
- ```

Class app{
 public static void main(String args[]){
 int x=1000;
 int y=100,z=100;
 int a,b;
 try{
 a=x/(y-z);}
 catch(ArithmeticException e);
 {
 System.out.println("Infinite");
 }
 finally{
 System.out.println("Hello World");
 }
 }
}

```
- (c) What will be the output of the following program segment? 01
- ```

import java.lang.*;
public class Example extends Thread {
    public void run() {
        System.out.println("Inside run() ");
    }
}
public static void main(String argsv[]){
    Thread.currentThread().setPriority(5);
    System.out.println("main thread Priority: " +
        Thread.currentThread().getPriority());
}

```
- (d) Why we use abstract and final keyword in java program? 04
4. (a) Explain following methods of collection interfaces: 3+3
- ```

containsAll(Collection c),subList(int startindex,int endindex),subMap(Object start,Object
end),setElementat(object e,int index)

```
- (b) What will be the output of the following program segments?
- ```

import java.util.*;
class Test{
    public static void main(String[] args){
        Set<String> ts = new TreeSet<>();
        ts.add("Greace");
        ts.add("For");
        ts.add("Geeks");
        ts.add("A");
        ts.add("B");
        ts.add("Z");
        for (String value : ts)
            System.out.print(value + ", ");
        System.out.println();}}
import java.io.File;
import java.io.IOException;
public class CreateFile {
    public static void main(String[] args) {
        try {
            File myObj = new File("filename.txt");
            if (myObj.createNewFile()) {System.out.println("F
created: " + myObj.getName());
            } else {
                System.out.println("File already exists.");
            } } catch (IOException e) {
                System.out.println("An error occurred.");
                e.printStackTrace();
            } } }

```

PART-B

(Answer any three questions)

5. (a) What is the difference between Exception and Error in Java? 02
- (b) What is the importance of finally block in exception handling? 02
- (c) Explain the following terms with respect to Exception Handling. 02
- i) try ii) catch iii) throw iv) throws
- (d) What is the output of the following program? 04
- ```

public class Test{
 public static void main(String args[]){
 int[] numbers ={10,20,30,40,50};
 for(int x : numbers){
 System.out.print(x);
 System.out.print(",");
 }
 System.out.print("\n");
 String[] names ={"James","Jarry","Tom","Jassy"};
 for(String name : names){
 if(name.startsWith("Ja") {
 name = name + " Watson"
 }
 System.out.print(name);
 System.out.print("\n");
 } } }

```



- ✓
6. (a) What will be output of the following program? 03
- |                                                                                                                                                                                                        |                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>class Demo implements Runnable{     public void run(){         for(int i=10;i&gt;0;i--){             System.out.println("\nThread: "+i); }         System.out.println("End of Thread"); } }</pre> | <pre>class Test{     public static void main(String args[]){         Demo obj=new Demo();         Thread tobj =new Thread(obj);         tobj.start();         System.out.println("End of main Thread"); }</pre> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- (b) Define synchronization? Consider the following Java program segment. X and Y as int variables. What will be the output if Y initialized to 5? What will be the output if Y initialized to 0? 2+3
- |                                                                                                                                                 |                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>X=5; try{     p=X/Y;     System.out.println("Inside try");} catch(NumberFormatException e){     System.out.println("Inside catch");}</pre> | <pre>catch(Exception e){     System.out.println("Inside exception");} finally{     System.out.println("Inside finally");} System.out.println("Inside main");</pre> |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- (c) Write the states of life cycle of an applet and draw state transition diagram 02
7. (a) How applets differ from application. Suppose left side of program segment (A.java) is in p1 package and Right side of program segment (B.java) is in mypack package. What will be the output 2+3
- |                                                                                                       |                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>package p1; public class A{     public void msg(){         System.out.println("Hello");} }</pre> | <pre>package mypack; import p1.A; class B{     public static void main(String args[]){         A obj = new A();         obj.msg(); } }</pre> |
|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
- (b) Is the following program segment is correct? If not make a correction of it. 03
- |                                                                                                                                                                                                                               |                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>public class GraphicsDemo extends Applet{     public void paint(Graphics g){         g.setColor(Color.red);         g.drawString("Welcome",50, 50);         g.drawLine(20,300);         g.drawRect(70,100,30,30);}</pre> | <pre>g.fillRect(170,100,30,30); g.drawOval(70,200,30,30); g.setColor(Color.pink); g.fillOval(170,200,30,30); g.drawArc(90,150,30,30,30,270); g.fillArc(270,150,30,30,0,180); } }</pre> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- (c) Write name of state of an applet life cycle and draw an applet's transition diagram. 02
8. (a) Suppose you have text file named "data.txt" contains text "CSESEC 15<sup>th</sup> batch". What will be the output of the following program segment? 03
- |                                                                                                                                                                                                                                       |                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>import java.io.FileWriter; class Main {     public static void main(String args[]) {         String data = "This is the data in the output file";         try {             FileWriter output= new FileWriter("data.txt");</pre> | <pre>output.write(data); System.out.println("Data is written to t file."); output.close();} catch (Exception e) {     e.printStackTrace();} }</pre> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
- (b) Is the following program segment is correct? If not make a correction of it. 03
- |                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>1. class button { 2.     button(){ 3.         Frame f = new Frame(); 4.         Button b1 = new Button("OK"); 5.         b1.setBounds(100, 50, 50, 50); 6.         f.add(); 7.         Button b2 = new Button("SUBMIT"); 8.         b2.setBounds(100, 101, 50, 50); 9.         f.add(b2);</pre> | <pre>10. Button b3 = new     Button("CANCEL"); 11. b3.setBounds(100, 150, 80, 50); 12. f.add(b3); 13. f.setSize(500, 500); 14. f.setLayout(null); 15. f.setVisible(true); 16. } 17. public static void main(String     a[]) { new button(); } }</pre> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- (c) Write syntax of exception handling code? Suppose you created an applet name "CSESEC.java". Now write a full HTML code to embed with it in a web page. 1+3



**Sylhet Engineering College, Sylhet**  
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**Department of Computer Science & Engineering**

Final Examination, 2023

Course No: EEE 309

Time: 02 (Two) hours

2<sup>nd</sup> year 1<sup>st</sup> Semester

Course Title: Electronic Devices and Circuits

Full Marks: 40

N.B. : (i) Answer any two question from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)-----N/A-----

**PART-A**

(Answer any two questions)

1. (a) Give the energy band description of conductors, semiconductors and insulators. 02
- (b) Find the current through the diode in the circuit shown in Fig. 1(b). Assume the diode to be ideal. 08

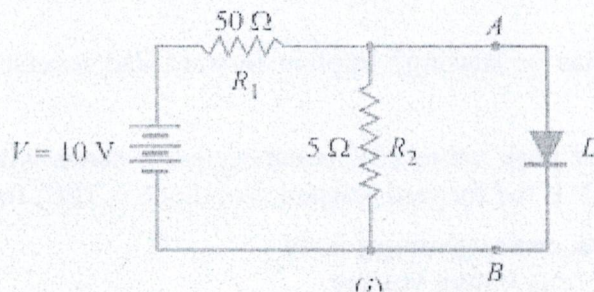


Figure 1(b)

2. (a) Make a list of the differences between the CE, CB, and CC configurations of BJTs. 02
- (b) For the emitter bias network shown in Fig. 2, determine: (i)  $I_B$ , and  $I_C$ , (ii)  $V_{CE}$ , 08  
 (iii)  $V_B$  and  $V_E$ , (iv)  $V_{BC}$ .

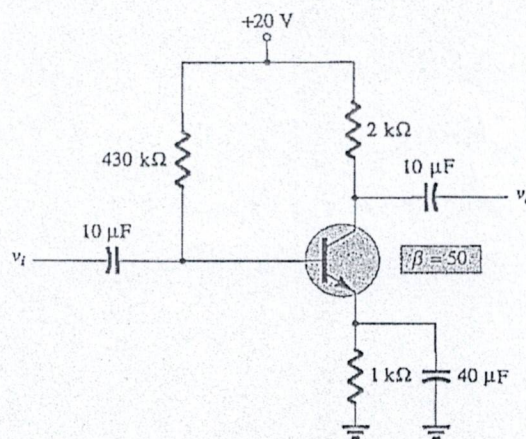


Fig. 2

3. (a) What is transistor? Explain transistor action. 02
- (b) For the fixed bias configuration circuit shown in Fig. 3, determine: (i)  $I_B$ , and  $I_C$ , (ii)  $V_{CE}$ , 08  
 (iii)  $V_B$  and  $V_C$ , (iv)  $V_{BC}$ . Assume transistor to be Silicon.

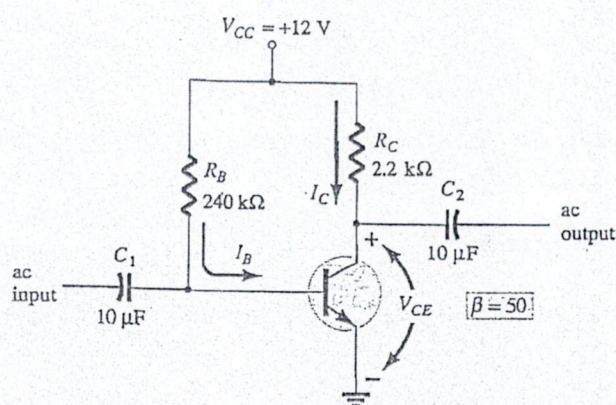


Fig. 3



**PART-B**

(Answer any two questions)

4. (a) Define filter. What are the applications of filter? 04
- (b) In a common base connection, current amplification factor is 0.9. If the emitter current is 1mA, determine the value of base current. 06
5. (a) Explain the difference between JFET and BJT. 02
- (b) A crystal diode having internal resistance  $r_f = 39 \Omega$  is used for half-wave rectification. If the applied voltage  $v = 45 \sin \omega t$  and load resistance  $R_L = 850 \Omega$  then find: 08
- i)  $I_m, I_{rms}, I_{dc}$
- ii) Input and output power
- iii) dc output voltage iv) efficiency
6. (a) What is Diode Bias or Biasing? Explain forward and reverse biasing of a p-n junction diode. 02
- (b) An a. c. voltage of peak value 20V is connected in series with a silicon diode and load resistance of  $500 \Omega$ . If the forward resistance of diode is  $10 \Omega$ , find: 08
- (i) Peak current through diode
- (ii) (ii) peak output voltage

What will be these values if the diode is assumed to be ideal?



**Sylhet Engineering College, Sylhet**  
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Department of Computer Science & Engineering

Final Examination, 2023

2<sup>nd</sup> Year 1<sup>st</sup> Semester

Course No: CSE303 Course Title: Mathematical Analysis for Computer Science & Theory of Computation

Time: 03 (Three) hours

Full Marks: 60

N.B. : (i) Answer any three question from each PART

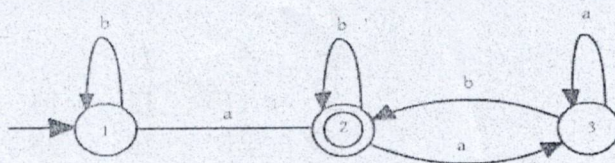
(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)-----N/A-----

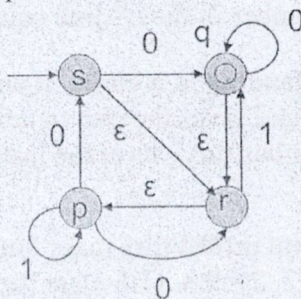
**PART-A**

(Answer any three questions)

1. (a) What do you mean by Automata?
- (b) Sketch the DFA given  $M = (\{q_1, q_2\}, \{0, 1\}, \delta, q, \{q_2\})$  and  $\delta$  is given by  $\delta(q_1, 0) = q_1$ ,  $\delta(q_2, 0) = q_1$ ,  $\delta(q_1, 1) = q_2$  and  $\delta(q_2, 1) = q_2$  determine a language  $L(M)$  that the DFA recognizes
- (c) What is the language accepted by the following DFA?



- (d) Convert the following NFA into equivalence DFA.



2. (a) Complete the Farey sequence Upto 5<sup>th</sup> level.
- (b) Construct a minimal DFA (mDFA) which accepts set of all strings over  $\{a, b\}$
- i.  $L(M) = \{W | W \text{ each string has exactly two } a\text{'s}\}$
- ii. which language  $L(M) = \{aa, aaa, aab, aba, ababa, aabba, aabbb, \dots\}$
- (c) For the continued fraction, write the corresponding number as a reduced fraction:  $[1; 4; 6; 4]$ . Determine the general term or generate an equation for the following sequence using the finite difference method. Sequence numbers 6, 13, 32, 69, 130, 221, ...
3. (a) Construct a NFA which accepts set of all strings over  $\{0, 1\}$  where each string  $L(M) = \{W | W \text{ second last symbol is always '1'}\}$
- (b) Convert NFA to DFA, which accepts a set of all strings over  $\{a, b\}$  where  $L(M) = \{W | W \text{ ends with "ab"}\}$
- (c) What do you mean by "CFG"? Construct a CFG which accepts the set of all strings over  $\{a, b\}$  where strings  $L(M) = \{W | W \text{ starts and ends with different symbol}\}$ . Draw a parse tree for 'abbaabb'.
- (d) Generate a Pseudo-Random number using congruential methods where the values of  $m = 9$ ,  $a = 7$ ,  $c = 4$ , and  $x_0 = 3$ .
4. (a) Describe the term "Turing Machine". Construct a Turing Machine (TM) for the Language,  $L = \{a^n b^n\}$  where  $n \geq 1$ .
- (b) What do you mean by "CNF"? Convert the given CFG to CNF. Consider the given grammar  $G_1$ :
- $$\begin{aligned} S &\rightarrow ASA \mid aB \\ A &\rightarrow B \mid S \\ B &\rightarrow b \mid \epsilon \end{aligned}$$
- (c) Write the most significant application of CNF.



**PART-B**  
(Answer any three questions)

5. (a) If a pizza is cut in such a way (using straight cuts) that the number of the pieces obtained are the maximum in each stage- 04  
 i. What is the maximum number of pieces that can be obtained with 4 cuts?  
 ii. Demonstrate the formula for the greatest number of pieces obtained with n cuts  
 (b) The Tower of Hanoi problem is a classic mathematical puzzle. There are three rods and a number of disks of different sizes which can slide onto any rod. Write the conditions and find the recursive formula to solve the tower of Hanoi problem of N disks. 04  
 (c) How many discs we can solve at most in whole of our life? [Assume we may live further 80 more years!] 02
6. (a) Define Relative prime. Explain the Euclidean algorithm and calculate the greatest common divisor of 3084 and 1424 Using the Euclidean Algorithm. 04  
 (b) Consider the following sequence. 03

1  
 3      5      7  
 9      11      13      15      17  
 19      21      23      25      27      29      31

- i) Determine the first number in the  $n^{\text{th}}$  line equation.  
 ii) Determine the last number in the  $n^{\text{th}}$  line equation.
- (c) Suppose that 101 people standing in a circle in an order 1 to 101. No.1 has a gun. He kills the next person (i.e. no. 2) and gives the gun to next (i.e. no.3). All people do the same until only 1 survives. Which number survives at the last and what formula can be applied to solve this? 03
7. (a) Suppose that  $p(x, y)$ , the joint probability mass function of X and Y, is given by  $p(1, 1)=0.4$ ,  $p(1, 2)=0.2$ ,  $p(2, 1)=0.1$ ,  $p(2, 2)=0.3$ . Calculate the conditional probability mass function of X given that  $Y=2$ . 02  
 (b) Consider the original message. "PANI LAGBE KARU PANI" is sent by your friend, and the key is "Mugdho". Now find the secret message according to the Vigenere cipher. 03  
 (c) Define Tiny Encryption Algorithm. RSA works best in the cases of encryption and verification. Suppose an RSA cryptosystem, a particular Alisa uses two prime numbers  $p=5$  and  $q=3$  to generate her public and private keys. What is the value of cipher text for a plain text=14? 05
8. (a) What do you mean by stochastic process? Suppose the following table gives the initial distribution of people in the three income classes. 05

| Class  | State | Proportion |
|--------|-------|------------|
| Lower  | 1     | 21%        |
| Middle | 2     | 68%        |
| Upper  | 3     | 11%        |

How these proportions would change after one generation? Draw the tree diagram.

- (b) A Markov chain has transition matrix 2.5\*2  
 i)

$$\begin{matrix} & \begin{matrix} 1 & 2 & 3 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} & \begin{bmatrix} 0.3 & 0.6 & 0.1 \\ 0 & 1 & 0 \\ 0.6 & 0.2 & 0.2 \end{bmatrix} \end{matrix} = P.$$

ii)

$$\begin{matrix} & \begin{matrix} 1 & 2 & 3 & 4 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} & \begin{bmatrix} 0.6 & 0 & 0.4 & 0 \\ 0 & 1 & 0 & 0 \\ 0.9 & 0 & 0.1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \end{matrix}$$

Draw the transition diagram of the matrix