



# SASTRA

SAKSHI ANTI TRAFFIC UNIT

DEEMED TO BE UNIVERSITY



THINK MEET / THINK TRANSACT / THINK SASTRA

School of Computer Science  
First CIA Examination - May

Course Code: INT104

Course Name: DATABASE  
MANAGEMENT SYSTEMS

Duration: 90 minutes Max Marks: 50

## PART A

Answer all the questions

10 \* 2 = 20 Marks

1. Identify any two types of DBMS Users and explain their roles.
2. Discuss any two unary operators in relational algebra.
3. Differentiate left and right outer join operations
4. Discuss the difference between union and union all in SQL
5. Write SQL Query to print all the records from student table who lives in city Thanjavur and also age less than 20
6. What is the syntax to alter a table using SQL
7. Name any 4 constraints in DBMS and its need.
8. Differentiate primary and secondary index.
9. Differentiate physical vs conceptual data independence.
10. What is a cartesian product in relational algebra. Explain with small example

## PART B

Answer all the questions

3 \* 10 = 30 Marks

11. Discuss in detail any three data models
12. Discuss in detail 3-Schema Architecture
13. Design ER Model for a Company Database.

The company is organized into DEPARTMENTS. Each department has a name, number and an employee who manages the department. A department may have several locations.

Each department controls a number of PROJECTS. Each project has a unique name, unique number and is located at a single location. We store each EMPLOYEE's social security number, address, salary, sex and birthdate. Each employee works for one department but may work on several projects. We keep track of the number of hours per week that an employee currently works on each project. We also keep track of the direct supervisor of each employee.

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**SASTRA**

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School of Computing  
Second CIA Examination – Oct 2023  
Course Code: INT104  
Course Name: DATABASE  
MANAGEMENT SYSTEMS  
Duration: 90 minutes Max Marks: 50

PART A

Answer all the questions

5 \* 2 = 10 Marks

1. Differentiate clustered index and secondary index.
2. Draw the node structure of B+ tree.
3. Write an SQL query to find the top three salary from the employee table.
4. Compare full functional dependency and partial functional dependency.
5. Compare transaction and process.

PART B

Answer all the questions

3 \* 10 = 30 Marks

6. Discuss the general guidelines for a good database design with examples.
7. Discuss the following with examples:  
a. 3nf                      b. 3.5nf
8. With a neat diagram explain any two types of hashing techniques with example.

PART C

Answer all the questions

1 \* 10 = 10 Marks

9. Explain the problems that may occur with concurrent transactions.



**SASTRA**

SRINIVASA KRISHNAN UNIVERSITY

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TRUSTWORTHY | THINK TRANSPARENTLY | TRULY ACT



School of Computing  
Third CIA Examination –Nov 2023  
Course Code: INT104  
Course Name: DATABASE  
MANAGEMENT SYSTEMS  
Duration: 90 minutes Max Marks: 50

### PART A

Answer all the questions

5 \* 2 = 10 Marks

1. Differentiate relational vs OODB Model
2. Compare Serial Vs Non-serial Schedule
3. Differentiate deadlock vs starvation
4. Draw the wait-for graph with an example.
5. Write the rules for conflict serializable.

### PART B

Answer any three questions

3 \* 10 = 30 Marks

6. Discuss in detail the complex datatypes associated with object-oriented databases.
7. Discuss the following with examples  
a. View serializable b. conflict serializable
8. With a neat diagram explain the components of data warehouse.
9. With a neat diagram explain the transaction states and properties of transaction
10. Draw an ER diagram to discuss the scenario of ICC cricket world cup.

### PART C

Answer any one the questions

1 \* 10 = 10 Marks

11. Discuss any three functional dependencies with example.
12. Discuss the deadlock prevention techniques in transaction processing





# SASTRA

SALEM INSTITUTE OF TECHNOLOGY



School of Computing  
First CIA Exam - Sept 2023  
Course Code: CSE214  
Course Name: Computational Statistics  
Duration: 90 minutes Max Marks: 50

## PART A

Answer all the questions

35 marks

1. Find out the regression coefficient of advertisement and predict sales & profit value for the given data and find the error based on prediction.

$$\text{Sales}^T = [5, 6, 7, 8, 9]; \text{Profit}^T = [3, 4, 5, 6, 7];$$

$$\text{Advertise}^T = [0.5, 0.6, 0.7, 0.8, 0.9] \quad (17)$$

2. Derive the estimation of model parameter of multiple linear regression model. (10)

3. Sales (in lakhs) of two products P1 and P2 for many branches where the amount follow a bivariate normal distribution with parameters:

- $\mu_x = 80$  and  $\mu_y = 90$ . Are the marginal means
- $\sigma_x = 20$  and  $\sigma_y = 25$  are the marginal standard deviation
- $\rho = 0.70$  Is the correlation co-efficient

Suppose we select branch at random, what is the probability that

- a) A branch sales over 95 for P2?  
b) The sum of P1 and P2 over 180?

$$\phi(-0.24) = 0.59; \phi(-0.2) = 0.58; \phi(-1) = 0.16; \phi(1) = 0.84; \quad (8)$$

## PART B

Answer all the questions

15 marks

4. Derive the equation of independent multivariate normal distribution (15)



# SASTRA

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THINK HEART | THINK TRANSPARENCY | THINK SASTRA



School of Computing  
Second CIA Exam - Oct 2023

Course Code: CSE214

Course Name: Computational Statistics

Duration: 90 minutes Max Marks: 50

## PART A

Answer ANY TWO questions

30 marks

1. Calculate Fisher discriminant score for the data  $X_0^T = [-2, -3]$  and allocate it to the appropriate groups:  $n_2=n_3=3$ ,  $p_1=p_2=0.2$ ,  $p_3=0.6$ .

$$\begin{aligned} \pi_1: X_1 &= \begin{bmatrix} -1 & 5 \\ 1 & 3 \\ 0 & 1 \end{bmatrix}; \bar{X}_1 = \begin{bmatrix} 0 \\ 3 \end{bmatrix}; \pi_2: X_2 = \begin{bmatrix} 1 & -2 \\ 0 & 0 \\ -1 & -4 \end{bmatrix}; \bar{X}_2 = \begin{bmatrix} 0 \\ -2 \end{bmatrix} \\ \pi_3: X_3 &= \begin{bmatrix} -2 & 0 \\ -2 & 1 \\ -2 & 5 \end{bmatrix}; \bar{X}_3 = \begin{bmatrix} -2 \\ 2 \end{bmatrix} S_{pooled}^{-1} = \begin{bmatrix} 1.03 & 0.09 \\ 0.09 & 0.26 \end{bmatrix} \quad (15) \end{aligned}$$

2. Derive the steps of calculating Principal Components. (15)
3. From the factor model derive the variance explained by the factors (15)

## PART B

Answer the question

20 marks

4. a) Considers the following eigenvalues (5, 10, 10) and

eigen vectors  $\begin{bmatrix} 1.25 & -2 & -1 \\ -0.5 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$ .

Apply Spectral Decomposition theorem and consider the number of Components to be selected is 2. (10)

- b) Apply Fisher discriminant distance calculation and allocate  $X_0^T = [8.5, 318]$  to the either of group  $\pi_1$  or  $\pi_2$ . Mean of points in  $\pi_1, \pi_2$  and  $\pi_3$  are  $\bar{X}_1 = \begin{bmatrix} 7.2 \\ 295 \end{bmatrix}$ ;  $\bar{X}_2 = \begin{bmatrix} 8.2 \\ 312 \end{bmatrix}$ ;  $\bar{X}_3 = \begin{bmatrix} 8.8 \\ 323 \end{bmatrix}$

$$S_{pooled}^{-1} = \begin{bmatrix} 1.07 & -0.09 \\ -0.09 & 0.27 \end{bmatrix} \quad (6)$$

- c) Distinguish exploratory and confirmatory factor model (4)



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SAKSHI ACADEMY OF STUDENT SUPPORT  
DEVELOPMENT UNIVERSITY



School of Computing  
Third CIA Exam – Nov 2023

Course Code: CSE214

Course Name: Computational Statistics

Duration: 90 minutes Max Marks: 50

Answer ANY TWO questions

**PART A**

**30 marks**

1. a) Consider the hypothetical distance between pairs of five objects as follows. Construct dendrogram using single linkage clustering.

$$D = \begin{bmatrix} 0 & & & & \\ 10 & 0 & & & \\ 4 & 8 & 0 & & \\ 7 & 6 & 10 & 0 & \\ 12 & 11 & 3 & 9 & 0 \end{bmatrix} \quad (10)$$

- b) Assume  $X_1$  and  $X_2$  are two features with  $n_1, n_2$  rows, discuss the spooled calculation. (5)

- 2.a) Amazon is planning for analyzing their sales data  $X$  and constructed factors. Calculate covariance. (10)

$$\text{Loadings} = \begin{bmatrix} 0.46 & 0.92 \\ 0.68 & -0.43 \\ 0.75 & 0.65 \\ 0.84 & -0.2 \\ 0.83 & -0.64 \end{bmatrix}$$

- b) Interpret the following confusion matrix by calculating APER and accuracy percentage. (5)

Confusion matrix		Predicted	
Actual		No	Yes
	No	650	27
	Yes	76	534

3. a) Derive the covariance of regression coefficient of linear regression model. (10)

- b) Discuss error calculation of MLR prediction with example. (5)

Answer the question

**PART B**

**20 marks**

4. Two dimensional data  $X=(3.2, 2.5, 4.3, 3.8, 5.1, 4.8)$ ,  $Y=(1.5, 4.4, 6.5, 3.9, 7.2, 6.4)$  are given. Apply kmeans clustering to divide the items into two groups. Discuss stopping criteria. Calculate Scatter coefficient. (20)

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PART A (2x10=20)

Answer all the questions

1. Define class and object with suitable example.
2. What is meant by encapsulation?
3. What is the significance of inheritance in object-oriented programming and list its various types?
4. In what scenarios should a class include a virtual function?
5. Write short note on Access Specifiers.
6. What is meant by Dynamic Memory Allocation?
7. Predict the output

```
class MyClass {  
public:  
    static int staticVar;  
    const int constVar;  
    MyClass(int value) : constVar(value) {}  
    void displayValues() {  
        staticVar++;  
        cout<<"static var= "<<staticVar<<" constant  
var="<<constVar<<endl;  
    } };  
int MyClass::staticVar = 0;  
int main() {  
    MyClass obj1(10);  
    MyClass obj2(20);  
    obj1.displayValues();  
    obj2.displayValues();  
    return 0; }
```

8. What is an abstract class?
9. Compare and contrast static binding and late binding.

10. What are templates in C++? How do they facilitate generic programming?

PART B (3x10=30)

Answer All the Three Questions

11. Create a class called Book with the following attributes: title, author, ISBN, publicationYear, and price. Implement necessary constructors and member functions to set and display these attributes. In the main() function, create an array of 3 Book objects, populate them with information, and find and display the details of the book with the highest price using the > operator (as a friend function for comparison).
12. Create a base class SportsTeam with teamName, coachName, and city attributes. Include a virtual function printAdditionalInfo().
- Create derived classes SoccerTeam, BasketballTeam, and TennisTeam. Override printAdditionalInfo() in each class and add specialized attributes: numPlayers, teamCaptain, and rank.
  - Implement constructors to initialize attributes.
13. Write a C++ program that defines a template function findMax to find the maximum of two values of any data type. Additionally, create a **template specialization for the char data type** to find the maximum character in a case-insensitive manner. In the main function, demonstrate the use of the findMax function with the following test cases:
- Find the maximum of two integers.
  - Find the maximum of two doubles.
  - Find the maximum of two characters while ignoring case sensitivity.



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**SASTRA**

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THINK FIRST THINK TRUTH THINK SASTRA



School of Computing  
Third CIA Examination – Nov 2023

Course Code: CSE213

Course Name: Object Oriented Programming

Duration: 90 minutes Max Marks: 50

**PART A (2x10=20)**

**Answer all the questions**

1. Write the Trigraph equivalent for the following a) ??= b) ??/ c) ??' d) ??(
2. What is the difference between function overloading and template?
3. List the different modes in which file can be opened.
4. Is there any way to access class private members without its objects? Justify your answer.

5. Compute the output for the following code:

```
#include <iostream>
using namespace std;
class room {
    int width, length;
    void setvalue(int w, int h)
    {
        width = w;
        length = h;
        cout<<width<<length;
    }
};
int main() {
    room obj;
    obj.setvalue(12,24);
    return 0;
}
```

6. What is the purpose of UML?
7. Distinguish the aggregation and composition.

8. List the advantages of overloading.
9. Illustrate encapsulation.
10. Differentiate static and non-static data members.

**PART B (3x10=30)**

**Answer Any Three Questions**

11. Write a C++ program to read a file that contains integers. Read the integers and categorize them as even or odd. Store all even integers in a file called EVEN.TXT and all odd numbers in ODD.TXT.
12. Write a C++ program that has a class Train with data members as no\_of\_seats\_Itier, no-of\_seats\_IItier, no-of\_seats\_IIItier and member function to set and display data. Derive a class Reservation that has data members seats\_booked\_Itier,seats\_booked\_IItier,seats\_booked\_IIItier and functions to book and cancel tickets and display the status.
13. Draw Class Diagram, Sequence Diagram and Activity Diagram for Online Railway ticket reservation system.
14. Explain the following with example i) Abstraction, ii) Inheritance, iii) Polymorphohism and iv) Encapsulation



# SASTRA

SAKSHI ANTHEM UNIVERSITY



School of Computing

First CIA Examination - Sep 2023

Course Code: CSE213

Course Name: Object Oriented Programming

Duration: 90 minutes Max Marks: 50

## PART A (2x10=20)

### Answer all the questions

1. Distinguish between structures and classes.
2. Fill in the blank with Trigraph Sequences  
\_\_\_\_ define MSG "Hello"  
\_\_\_\_ define Program "CSBS"  
int main()  
  
\_\_\_\_  
cout << "My message to " << MSG << endl;  
cout << "My program is " << Program;  
return 0;
3. List the various methods of passing arguments to a function with example.
4. Define constructor and list its type.
5. Write the building blocks of Exception handling routine.
6. What is dangling pointer and memory leak?
7. Write short note on Enumeration data type with example.
8. Write the suitable technique to reduce function call overhead and justify it.
9. State the difference between #pragma startup and #pragma exit directives in terms of program execution.
10. Predict the output for the code

```
#include <iostream>
#include <iomanip>
using namespace std;
int main()
{
    cout << setfill('$') << setw(5);
    cout << "10" << endl;
}
```



### PART B (3x10=30)

#### Answer All the Three Questions

11. Consider a class named Calculator that contains overloaded functions for calculating areas of different geometric shapes. Implement the class with appropriate member functions to calculate the area of a rectangle, a circle, and a triangle.

Hint: The class should have public member functions named calculateArea for each of the following shapes:

Rectangle: calculateArea(double length, double width)

Circle: calculateArea(double radius)

Triangle: calculateArea(double base, double height)

12. Define a symbolic constant called STATE, set to initial value TAMILNADU. In the main() function, check if STATE is defined;

*if else* if yes, then  
check if its value is TAMILNADU;  
If YES, then  
    define another symbolic constant as CAPITAL with its  
    value set as Chennai.  
Else  
    Print the message "Name wrongly set"  
Else  
    Define a symbolic constant called STATE and set its  
    value as GUJARAT.

Implement the above using appropriate pre-processor directives and include test cases to verify all possible outputs.

13. Create a class called employee that contains a name (an object of class string) and an employee number (type long). Include a member function called getdata() to get data from the user for insertion into the object, and another function called putdata() to display the data. Assume the name has no embedded blanks. Write a main() program to exercise this class. It should create an array of type employee and then invite the user to input data for up to 100 employees. Finally, it should print out the data for all the employees.



# SASTRA

SALEM ENGINEERING UNIVERSITY

School of Computing  
Third CIA Test - NOV 2023

Course Code: CSE 212

Course Name: COMPUTER ORGANIZATION &  
ARCHITECTURE

Duration: 90 minutes

Max Marks: 50

## PART A

10 x 2 = 20 Marks

Answer all the Questions

1. Explain cache memories.
2. What is the Grey code for the decimal numbers 65 and 96?
3. What is meant by Instruction register?  
Define hazards in Pipelining
4. Solve the Boolean functions, using K-map  $F(x, y, z) = \sum(0, 1, 4, 5)$
5. Write the functions of memory mapped I/O.
6. Define vector processing.
7. Write the basic computer instruction code format.
8. What is Arbitration?
9. Write the different types of instruction sets in IA-32 processor

## PART B

Answer any two Questions

2 x 10 = 20 Marks

11. Discuss in detail about memory reference instructions with flow chart. (10)
12. Design a combinational circuit with three inputs x, y, z and three outputs A, B, C. When the binary input is 0, 1, 2, or 3, the binary output is one greater than the input. When the binary input is 4, 5, 6, or 7, the binary output is one less than the input. (10)
13. a) Justify the Operation of Superscalar processor. (5)  
b) Explain in detail about serial port and interface circuits. (5)

## PART C

Answer the Question

1 x 10 = 10 Marks

14. a) Design the accumulator logic with logic diagram. (5)  
b) Justify the use of DMA controllers in a computer system. (5)

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# SASTRA

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THINK SMART, LEARN FASTER, LIVE BETTER

School of Computing  
Second CIA Test – Oct 2023

Course Code: CSE212

Course Name: COMPUTER ORGANIZATION &  
ARCHITECTURE

Duration: 90 minutes

Max Marks: 50

## PART A

10 x 2 = 20 Marks

Answer all the Questions

1. What is meant by Microprogrammed control?
2. Find the effective address, if the addressing mode of the instruction is base with index and displacement mode. [Base register = 4000, Index register = 60 with scale factor of 4 and displacement is 400].
3. List the difference between Von Neumann and Harvard architecture.
4. Draw the state transition diagram of instruction cycle.
5. Define Instruction register.
6. Define straight line sequencing.
7. Define the basic principle of pipelining.
8. Represent these data1: 56A01FE2 and data2: 3678D5F6 in little-endian and in the big-endian format. *Big*
9. Define interrupts and exceptions.
10. Define status register of IA-32 bit processor.

## PART B

Answer all the Questions

3 x 10 = 30 Marks

11. Explain in detail about the RISC architecture and its addressing modes.
12. Explain in detail about the Intel Architecture-32 bit processor registers and its instruction set.
13. Explain in detail about timing and control unit with the flow chart for different type of instructions.





**SASTRA**  
SRI ANTHEM ENGINEERING COLLEGE  
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KUMARAKOTTAI - 621 006

School of Computing  
First CIA Test - Sep 2023

Course Code: CSE 212

Course Name: COMPUTATION OF DATA STRUCTURE & ARCHITECTURE

Duration: 90 minutes

Max. Marks: 70

### PART A

10 x 2 = 20 Marks

Answer all the Questions

1. Simplify the Boolean expressions to a minimum number of literals.  
a)  $A'B + ABC' + ABC$     b)  $(A'B + A'B'C'D) + A'B + AB = B$   
c)  $(BC' + A'D)(AB' + CD')$
2. What is the Grey code for the decimal numbers 36 and 52?
3. List the truth table for the function,  $F = xy'z + x'y'z + xyz$
4. Represent the unsigned decimal numbers 576 and 892 in BCD.
5. Solve the Boolean functions, using K-map  $F(x, y, z) = \sum(3, 5, 6, 7)$
6. Write Demorgan's law.
7. Explain the truth table of EX-OR and EX-NOR gates.
8. Convert the following numbers with the indicated bases to decimal.  
a)  $(11010)_2$     b)  $(24)_{16}$     c)  $(36)_8$
9. Define binary number representation.
10. Find the 10's complement of 123900.

### PART B

Answer all the Questions

3 x 10 = 30 Marks

11. Simplify the following Boolean function in product-of-sums form by means of a four-variable map. Draw the logic diagram with (a) OR-AND gates (b) NOR gates.  
$$F(A, B, C, D) = \sum(2, 3, 4, 5, 6, 7, 11, 14, 15)$$
12. Design a sequential circuit with two JK flip flops A and B and two inputs E and X. If E=0, the circuit remains in the same state regardless of the value of X. When E=1 and X=1, the circuit goes through the state transitions from 00 to 01 to 10 to 11 back to 00, and repeat. When E=1 and X=0, the circuit goes through the state transitions from 00 to 11 to 10 to 01 back to 00, and repeat.
13. Derive and explain an algorithm for fixed point unsigned binary multiplication with an example.



**SASTRA**  
SRI ANANTH UNIVERSITY



WENT TO BE UNIVERSITY

1. PARAMBIL ENGINEERING COLLEGE

School of Computing  
Third CIA Examination - NOV 2023  
Course Code: CSE211  
Course Name: Formal Language and Automata Theory  
Duration: 90 minutes. Max Marks: 50

**PART A Answer all the questions**

**10\*2=20 marks**

1. State Myhill-Nerode theorem.
2. Find a regular expression for  $L = \{w \in \{0,1\}^* : 'w' \text{ has no pair of consecutive zeros}\}$ .
3. Define derivation tree.
4. Differentiate Chomsky and Greibach normal form.
5. Write the format of unrestricted grammar.
6. List out the observations on Turing's thesis.
7. Write context sensitive grammar for  $L = \{a^n b^n c^n : n > 0\}$ .
8. What is a diagonalization language?
9. State Rice theorem.
10. Rewrite the Boolean expression in conjunctive normal form.  
 $(x_1 \wedge x_2) \vee x_3$

$$(x_1 + x_2) \cdot x_3$$

$$(x_1 \cdot x_2) + (x_2 \cdot x_3)$$

$$(x_1 \vee x_2) \wedge (x_2 \vee x_3)$$

**PART B Answer any 2 questions**

**2\*10=20 marks**

11. Draw the architecture and explain the working of multi-tape & multi-dimension turing machines.
12. Check whether the given grammar is ambiguous or not. If ambiguous, rewrite it and produce an unambiguous grammar.

$E \rightarrow I / E + E / E * E / (E)$

$I \rightarrow a / b / c$

13. Explain in detail about the closure properties of regular languages.

**PART C**

**1\*10=10 marks**

14. Explain in detail about Polynomial and Non-Polynomial Time Classes with suitable examples.



**PART A**

Answer all the questions

10-3-18, 2018

1. Describe about grammar in automata theory.
2. Show the category of languages in 'Chomsky's hierarchy'.
3. Differentiate NFA and DFA.
4. Find a regular expression for  $L = \{w \in \{0,1\}^* : w \text{ has at least one pair of consecutive zeros}\}$ .
5. Define homomorphism in closure property of regular language.
6. Draw the parse tree for the string "abbbb" with the productions  $S \rightarrow aAB, A \rightarrow bBb, B \rightarrow A/\epsilon$ .
7. How can you tell if a grammar is ambiguous?
8. Write down the steps for converting NFA to DFA.
9. State Kleene's theorem.
10. What is the minimization problem of DFA?


**PART B**

Answer all the questions

3\*10=30 marks

11. Construct a Deterministic Finite Automata (DFA) for the language  $L = \{w : n_a(w) \bmod 3 > n_b(w) \bmod 3\}$  where  $\Sigma = \{a,b\}$ .
12. Write the procedure for converting NFA to RE. Find the regular expression for the language  $L = \{w \in \{a,b\}^* : n_a(w) \text{ is even and } n_b(w) \text{ is odd}\}$ .
13. a) Show that  $L = \{ww^R : w \in \{a,b\}^*\}$  is not regular. (5 marks)  
b) Construct a Context Free Grammar for language  $L = \{a^n b^m : n \neq m\}$ . (5 marks)



 <p><b>SASTRA</b> SARAJITHA ANTHONY SASTRIAN DELMED TO BE UNIVERSITY THINKING IS THE KEY TO KNOWLEDGE</p>	<p>School of Computing Second CIA Examination – OCT 2023 Course Code: CSE211 Course Name: Formal Language and Automata Theory Duration: 90 minutes      Max Marks: 50</p>
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### PART A

Answer all the questions

10\*2=20 marks

1. Define Linear Bounded Automata.
2. Write down the format of context sensitive grammar.
3. Eliminate useless productions from the given grammar  
 $S \rightarrow aSb / \lambda / A$        $A \rightarrow aA$
4. Transform the given grammar into GNF.  
 $S \rightarrow AB$ ,       $A \rightarrow aA / bB / b$ ,       $B \rightarrow b$
5. Write PDA for the given CFG.  
 $S \rightarrow aA$ ,       $A \rightarrow aABC / bB / a$ ,       $B \rightarrow b$ ,       $C \rightarrow c$
6. Discuss the closure properties of context free languages.
7. Draw the architecture of Turing Machine.
8. Differentiate NPDA and DPDA.
9. Design a TM which performs 1's complement.
10. Write the rules to convert PDA to CFG.

### PART B

Answer any 3 questions

3\*10=30 marks

11. Construct a NPDA to accept the language  $L = \{a^n b^n c^m d^m, \text{ where } m, n \geq 1\}$ .
12. Design a TM to accept the language  $L = \{WW^R : W \in (a,b)^+\}$ .
13. Eliminate  $\lambda$  or unit productions in the given grammar and then convert the resultant grammar into Chomsky normal form.  
 $S \rightarrow AB / aB$ ,       $A \rightarrow aab / \lambda$ ,       $B \rightarrow bbA$
14. Prove that the language  $L = \{a^n b^n c^n : n \geq 0\}$  is not context free.