

SASTRA
DEemed To Be University
SCHOOL OF COMPUTING

SAASTRA UNIVERSITY
KUMARASWAMY NAGAR
CHENNAI - 600 096

School of Computing
First CIATest - September, 2022
CourseCode: INT104
CourseName: Database Management Systems
Duration: 90 minutes. MaxMarks: 50

Answer all the questions PART-A

(10x2=20 Marks)

1. What are the advantages of using a DBMS?
2. Label the main characteristics of the database approach.
3. List four applications you have used that most likely employed a database system to store persistent data.
4. Explain the difference between two-tier and three-tier architectures.
Which is better suited for Web applications? Why?
5. List out the different data models.
6. Define instance and schema.
7. Define domain, candidate key and super key.
8. Mention the attribute types and give an example.
9. What are the categories of SQL commands?
10. What is ON DELETE CASCADE?

Answer all the questions

PART-B

(3x10=30 Marks)

11. With the help of a neat block diagram explain the basic architecture of a database management system?
12. Design a database using ER diagram for a mobile shop. This mobile shop maintains information about entities: customer, mobile, bills, and login. Customer has attributes: cid, cname, address, phone, type, the cname is composed of first_name, middle_name, and last_name. Mobile has attributes: model, name, brand, IMEINo. A customer may purchase one or more mobile and request only one bill for payment. Login has attributes: user_id and password. Bill has attributes: billno, cname, amount. State any assumptions made in the design of the E-R diagram.

13 Construct a SQL statement for each of the following questions. The questions are based on the following Tables:

Employee: Empid Number(5), Empname Varchar(20), Job
Varchar(10), DOJDate, DeptNo Number(2), Salary Number
(7,2), Commission Number(5).

Department: DeptNo Number(2), DeptName Varchar(20), ManagerId
Number(5), Location Varchar(10).

1. Create the above-mentioned tables.
2. Include appropriate versions of all primary and foreign key constraints.
3. Adding a new column namely address in Employee table.
4. Change the salary column is 1500 and Commission is 10% of salary where DeptNo is 10.
5. List the Empname, DeptNo, Salary of the employees work in 'NEW YORK'.



School of Computing
 II CIA Exam - Nov 2022 (B.Tech)
 Course Code: INT104
 Course Name: Database Management
 Systems
 Duration: 90 minutes Max Marks:
 50

Answer all the questions

PART-A

(10X2=20 Marks)

1. List out the relational operations.
2. Show the difference between correlated and non-correlated subquery.
3. Compare table and view in SQL
4. Review this SQL Statement: `SELECT ename, emp_number, salary
FROM employee WHERE dept_number = (SELECT dept_number
FROM department WHERE location IN('CHICAGO','ATLANTA'))`
Why may this statement return an error?
5. List out various type of anomalies that leads to database inconsistency.
6. Label the different types of functional dependencies.
7. Define BCNF
8. Write a SQL command to find the second maximum salary in employee table.
9. Draw the transaction transition diagram.
10. Compare serial and non-serial schedule.

Answer any three questions PART-B

(3X10 = 30 Marks)

- Q1. With a neat sketch, illustrate the two different types of ordered indices and relatively show how they are differing to access a particular value using index entry to gain fast random access to records in a file.
- Q2. When is Normalization needed? With necessary examples highlight cases where the need for normalization has been acutely felt. Make suitable references with respect to 1NF, 2NF and 3NF.
- Q3. Why concurrency control needed? Explain the various problems occur during concurrent transaction with example.
- Q4. Consider the given tables and construct the SQL query statement for the given scenario.
Department (DeptId, DeptName)
Employee (EmpId, EName, EmpSal, Location, DOJ, MGRId, DeptID, Designation)
 Assume that the above tables created accordingly with necessary keys. You have entered some records into both of these tables.
 1) Display all the employees irrespective of whether they have tagged to a department or not?
 2) Display all the department details, whether employee tagged to it or not?
 3) Display the employee details, whose location is same as Peter.
 4) Display location wise salary if it is greater than 10000?
 5) Display all the Employees who are reporting to madhav's manager.
 6) Find the highest earning employee in each department.



School of Computing
III CIA Exam - Dec 2022 (B.Tech)
Course Code: INT104
Course Name: Database Management
Systems
Duration: 90 minutes Max Marks: 50

Answer any four questions PART A (4X10=40 Marks)

1. Explain the architecture of a database system and its various components along with suitable diagram.
2. Design a database using ER model to store IPL match details based on the requirements given below.
 - a. Player will have id, name, country and price
 - b. Team will have short name, name, owner and home ground.
 - c. Each team will have at least one player
 - d. Each player plays for at most one team
 - e. Each team plays match against atleast one other team, on specified date, time and ground. Winner of the match should be recorded.

The ER diagram should specify entity sets, relationship sets, participation details, cardinality ratio, primary key and weak entity sets (if any). Convert the above ER diagram into Relational schema.

Explain the conversion steps briefly.
3. Explain the optimizer uses equivalence rules to transform expressions into other logically equivalent expressions.
4. The following table is already in first normal form (1NF). There is only one entry per field. Convert this table to the third normal form (3NF) using the techniques you learned.

A. table with the students and their grades in different topics.

| UnitID | StudentID | Date | TutorID | Topic | Room | Grade | Book | TutEmail |
|--------|-----------|----------|---------|-------|------|-------|-----------|--------------|
| U1 | St1 | 25.02.03 | Tut1 | GMT | 629 | 4.7 | Deamitch | tut1@fabb.ch |
| U2 | St1 | 18.11.02 | Tut3 | GIn | 631 | 5.1 | Zehnder | tut3@fabb.ch |
| U1 | St4 | 23.02.03 | Tut1 | GMT | 629 | 4.3 | Deamitch | tut1@fabb.ch |
| U5 | St2 | 05.05.03 | Tut3 | PhF | 632 | 4.9 | Dümmers | tut3@fabb.ch |
| U4 | St2 | 01.07.03 | Tut5 | AVQ | 621 | 5.0 | SwissTopo | tut5@fabb.ch |

5. What are the various types of Distributed Database Systems? Explain fragmentation in distributed database systems.

6. Explain the data warehouse architecture and its components with a suitable diagram.

Answer the question

Part -B

(1X10 = 10 Marks)

7. (a) Construct an E-R diagram for a hospital with a set of patients and a set of medical doctors. Associate with each patient a log of the various tests and examinations conducted. (4)

(b) Create the table EMP with the following fields empno, name, job, salary, location, deptno, Date_of_joining where empno is primary key and insert the suitable records for the following questions. (6)

1. Implement the check constraint for the column salary is positive in emp table.
2. List all employee names starting with an 'S' and ending in a 'T'. The name must be at least five characters in size.
3. Display all details of employee whose name starts with 'S'
4. List all the names that starts with 'a' or 'b' or 'c'.
5. Create a sequence instseq with the following specifications minimum value 1, maximum value 20, increment by 1, start with 0, with cycle and cache 10.
6. Display the number of staff and total salary for each department.

SASTRA
DEEMED TO BE UNIVERSITY

School of Computing
First CIA Exam - Sept 2022
Course Code: CSE214
Course Name: Computational Statistics
Duration: 90 minutes Max Marks: 50

PART A

Answer all the questions

35 marks

1. Derive the covariance of regression coefficient of linear regression model. (8)

2. Find out the regression coefficient of advertisement and predict sales value for the given data and error. (12)

Sales^T = [5, 6, 7, 8, 9]; Advertisement^T = [0.5, 0.6, 0.7, 0.8, 0.9] x is independent. y is dependent.

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?

$$\phi(-0.24) = 0.59; \phi(-0.2) = 0.58; \phi(-1) = 0.16; \phi(1) = 0.84; \quad (7)$$

4. Calculate eigen values and eigen vector for the given matrix

$$\begin{bmatrix} 4 & 8 \\ 10 & 6 \end{bmatrix} \quad (8)$$

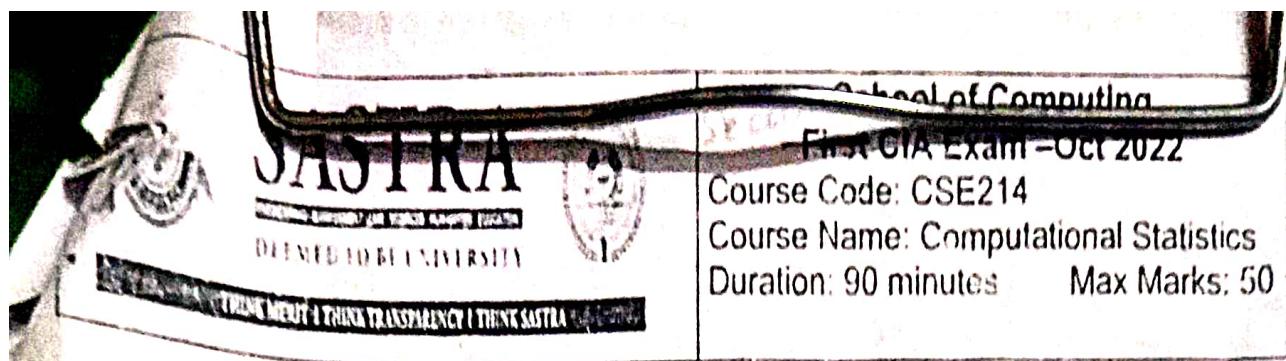
PART B

Answer all the questions

15 marks

5. Derive the equation of independent multivariate normal distribution

(15) *marks*

PART AAnswer ANY TWO questions40 marks

1. Fit a multivariate straight line model using the given data and prove

$$Y^T Y = \hat{Y}^T \hat{Y} + \hat{\varepsilon}^T \hat{\varepsilon}$$

$$Z^T = (2, 3, 4, 5, 6); Y_1^T = (2, 6, 8, 9, 12); Y_2^T = (-2, -2, 4, 6, 4) \quad (20)$$

- 2.a) Consider the following Eigenvalues (475, 6.09, 0.03, 0.82) and

Eigen vectors $\begin{bmatrix} 0.01 & 0.18 & -0.71 & 0.68 \\ 0.02 & 0.18 & 0.71 & 0.69 \\ 0.03 & 0.67 & 0 & -0.25 \\ -0.99 & 0.04 & 0.01 & 0.01 \end{bmatrix}$. Apply Spectral

Decomposition theorem and prove your selection of number of components. (10)

- b) In the process of separation of population, apply the maximum ratio formula and find the college in which the student can be admitted with his given CGPA and GRE scores $Y_0^T = [8.5, 319]$.

$$\bar{X}_1 = \begin{bmatrix} 7.2 \\ 295 \end{bmatrix}; \bar{X}_2 = \begin{bmatrix} 8.2 \\ 312 \end{bmatrix}; \bar{X}_3 = \begin{bmatrix} 8.8 \\ 323 \end{bmatrix}; S_{Pooled} = \begin{bmatrix} 0.96 & 0.32 \\ 0.32 & 3.87 \end{bmatrix} \quad (10)$$

3. Calculate Fisher discriminant score for the data $X_0^T = [-3, -2]$ and allocate it to the appropriate groups. $n_1=n_2=n_3=3$. $p_1=p_2=0.2, p_3=0.6$.

Low: $X_1 = \begin{bmatrix} -3 & 4 \\ -1 & 2 \\ -2 & 0 \end{bmatrix}; \bar{X}_1 = \begin{bmatrix} -2 \\ 2 \end{bmatrix}; S_1 = \begin{bmatrix} 1 & -1 \\ -1 & 4 \end{bmatrix}$

Med: $X_2 = \begin{bmatrix} -1 & 5 \\ 1 & 3 \\ 0 & 1 \end{bmatrix}; \bar{X}_2 = \begin{bmatrix} 0 \\ 3 \end{bmatrix}; S_2 = \begin{bmatrix} 1 & -1 \\ -1 & 4 \end{bmatrix}$

High: $X_3 = \begin{bmatrix} 1 & -2 \\ 0 & 0 \\ -1 & -4 \end{bmatrix}; \bar{X}_3 = \begin{bmatrix} 0 \\ -2 \end{bmatrix}; S_3 = \begin{bmatrix} 1 & 1 \\ 1 & 4 \end{bmatrix} \quad (20)$

PART BAnswer the question10 marks

4. Derive the steps of calculating Principal Components. (10)


SASTRA
 DEEMED TO BE UNIVERSITY

 School of Computing
 Third CIA Exam - Dec 2022
 Course Code: CSE214
 Course Name: Computational Statistics
 Duration: 90 minutes Max Marks: 50

Answer ANY TWO questions

PART A

40 marks

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

$$D = \begin{bmatrix} 0 & & & & \\ 10 & 0 & & & \\ 4 & 8 & 0 & & \\ 7 & 6 & 10 & 0 & \\ 12 & 11 & 3 & 9 & 0 \end{bmatrix} \quad (15)$$

- b) Distinguish Agglomerative and DIANA clustering. (5)

- 2.a) Two dimensional data $X=(3,2,4,3,5)$, $Y=(1,4,6,3,7)$ are given.
 - Apply kmeans clustering to divide the items into two groups. (15)
 b) Interpret the following confusion matrix by calculating APER and accuracy percentage. (5)

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

- 3.a) Derive the covariance of regression coefficient of linear regression model. (15)

- b) Distinguish exploratory factor analysis and confirmatory factor analysis. (5)

Answer the question

PART B

10 marks

4. Amazon is planning for analyzing their sales data X and constructed factors. Calculate covariance. (10)

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



SASTRA

DEEMED TO BE UNIVERSITY

ESTD. 1984



School of Computing
First CIA Exam - Sept 2022
Course Code: CSE213
Course Name: OBJECT ORIENTED
PROGRAMMING
Duration: 90 minutes Max Marks: 50

PART A

Answer all the questions

10X2=20 marks

1. Why do we need to use OOPs?
2. How data hiding is achieved in C++?
3. Predict output of following program.

```
int main()
{
    int a[2][2] = {{1,2},{3,4}};
    int i, j; for (i = 0; i < 2; i++) for (j = 0; j < 2; j++)
        cout << a[i][j]; return 0;
}
```

BY TAN

XMAS

4. List out rules for declaring of Constructor and Destructor.

5. Give the reason for passing arguments by reference.

6. Find the output of following code

```
void fun(int a, int* b = 100){cout << a << " " << b << endl;}
int main(){fun(5); return 0;}
```

5 100 the original value won't be restored

7. Predict output of following program.

```
int main(){ const char *pcName="C++programming";
pcName++; cout << pcName; return 0;}
```

8. Recall the use of scope resolution operator.

9. Do inline functions improve performance? Justify it.
10. Difference between Macros and Inline function.

PART B $3 \times 10 = 30$ marksAnswer all the questions

11. P is one-dimensional array of integers. Write a C++ function to efficiently search for a data VAL from P. If VAL is present in the array then the function should return value 1 and 0 otherwise.
12. Write a function that swap (exchanges the values of) two integers. Use int* as the arguments type. Write another swap function using int& as the arguments type. Overload the function in main().
13. Make a class called STUDENT with stu_id, Name, and Marks in 3 tests of a subject. Declare an array of 10 STUDENT objects. Use constructor to initialize data member and appropriate member functions, find the average of the marks for each student. Print the stu_id, Name and the average marks of all the students.

3/2



School of Computing
Second CIA Exam – Oct 2022

Course Code: CSE213

Course Name: OBJECT ORIENTED
PROGRAMMING

Duration: 90 minutes

Max Marks: 50

PART A

Answer all the questions

$$10 \times 2 = 20$$

1. List out the operators that cannot be overloaded.
2. Why is inheritance required?
3. In multiple inheritances, what is the order of calling the constructor? **O**
4. Consider the following declaration and answer the questions given below:

```
class PPP
{ int H; protected : int S;
public : void input (int); void out();}
```

```
class QQQ : private PPP
{ int T; protected : int U;
public : void indata(int, int); void outdata();}
```

```
class RRR : public QQQ
```

- ```
{ int M; public : void disp(); };
```
- i. Name the base class and derived class of the class QQQ **RRR**
- ii. Name the data member(s) that can be accessed from function disp(). **M**
- iii. Name the member function(s), which can be accessed from the objects of a class RRR int data, outdata, Disp.
- iv. Is the member function out() accessible by the object of the class QQQ? **yes**

5. How static data members differ from normal data members.

6. Find and locate the error (if any) /output of the following code:

```
#include <iostream>
```

```
using namespace std;
```

```

class Demo{private:int a;public:void set(int x){a = x;}
void sum(const Demo ob1, const Demo ob2){a = ob1.a++ + ob2.a;}
void print(){cout<<"Value of A : "<<a<<endl;}}
int main()
{
 Demo d1; Demo d2,d3;
 d1.set(10);d2.set(20);d3.sum(d1,d2);d1.print();d2.print();d3.print();
 return 0;
}

```

7. If an object of a class is declared as const type, should it be used only with the const member function? Justify your answer.
8. How can base class member function be invoked/called in a derived class if the derived class also has a member function with the same name.
9. Give the purpose of having friend function
10. Which cannot be inherited from the base class?

constructor

### PART B

Answer any TWO questions

2X15=30

11. Write a program to convert temperature from Celsius to Fahrenheit and vice versa using classes and type conversions concept. [Hint: Use conversion constructor in destination class. Formula: temp\_far = 1.8\*c)+32]
12. Write a class called LAPTOP with the data members name, cost, and RAM Size. Use the appropriate constructor. Include functions to get and display details of the LAPTOP. Overload < operator to compare two LAPTOP based on the cost of the LAPTOP, which returns a boolean value. In main function, create an array of LAPTOP objects, and get details of the LAPTOP. Compare the two LAPTOP objects and display the name of the costlier LAPTOP.
13. Create three class namely Product, Manufacture and LCD\_TV. Product class has data members model no, manufacture year, and no\_warranty\_yr and make it as abstract class. Manufacture class should privately inherit from Product class having data member as brand of the product and country name of the brand. LCD\_TV class publicly derived from Manufacture class having inch size and price of the TV. Include a member function to get and display the details of all class. In main function create the object for derived class and access the member function of base classes.

*Pre Processor directory*

**SASTRA**  
UNIVERSITY

DEEMED TO BE UNIVERSITY



School of Computing  
 Third CIA Examination - Dec 2022  
 Course Code: CSE213  
 Course Name: Object Oriented  
 Programming  
 Duration: 90 minutes      Max Marks: 50

**PART A**

**5x2=10MARKS**

1. Write a C++ program to swap two numbers using pass by reference.
2. Write a function nthroot() to calculate the nth root of a given value using inline function.
3. Why is it necessary for a code to handle exceptions?
4. Write a statement that writes a single character to an object called fileOut, which is of class ostream.
5. Sketch the UML notation for aggregation and composition with an example.

**PART B**

**2X15=30 MARKS**

Answer any two questions

6. Describe the OOP paradigms.
7. Write a program to add three values of different data types using static polymorphism.
8. Create a function called amax() that returns the value of the largest element in an array. The arguments to the function should be the address of the array and its size. Make this function into a template so it will work with an array of any numerical type. Write a main() program that applies this function to arrays of various types.
9. Draw a class diagram showing inheritance relationships among classes Person, Student, Employee, and technical assistant. Use access specifier in above classes.

**PART C**

**1X10=10MARKS**

10. Write a C++ program using a class to represent a bank Account with data members – name of depositor, account number, type of account, balance and member functions – deposit amount, withdraw amount, show name and balance. Check the program with your own data.



**SASTRA**  
DEEMED TO BE UNIVERSITY

First CLASS  
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. Solve the Boolean expressions to a minimum number of literals
  - a)  $A'B'C + AB'C + BC$
  - b)  $(BC' + A'D)(AB' + CD')$
2. What is the Grey code for the decimal numbers 25 and 49.
3. Reduce the Boolean expressions to two literals  $A'C' + ABC + AC$
4. Represent the unsigned decimal numbers 694 and 538 in BCD.
5. Solve the Boolean functions, using K-map  $F(x, y, z) = \Sigma(0, 1, 4, 5)$
6. Define Demorgan's law.
7. Explain the truth table and logical diagram of full adder.
8. Convert the following numbers with the indicated bases to decimal
  - a)  $(11010.0101)_2$
  - b)  $(16.5)_{16}$
  - c)  $(26.24)_8$
9. Define fixed and floating point representation
10. Find the 16's complement of CAD9.

### PART B

Answer all the Questions

3 x 10 = 30 Marks

11. Simplify the following Boolean function in sum-of-products form by means of a four-variable map. Draw the logic diagram with (a) AND-OR gates (b) NAND gates.  $F(A, B, C, D) = \Sigma(0, 2, 8, 9, 10, 11, 14, 15)$
12. Design a 2-bit count-down counter. This is a sequential circuit with two flip flops and one input x. When  $x=0$ , the state of the flip-flops does not change. When  $x=1$ , the state sequence is 11, 10, 01, 00, 11, and repeat.
13. Derive and explain an algorithm for adding and subtracting two fixed point signed magnitude binary numbers.



DEEMED TO BE UNIVERSITY

INTEGRITY TRUTH TRANSPARENCY THINK SASTRA

School of Computing  
Second CIA Test – Oct 2022

Course Code: CSE 212

Course Name: COMPUTER ORGANIZATION &  
ARCHITECTURE

Duration: 90 minutes

Max Marks: 50

**PART A**  
**Answer all the Questions**

**10 x 2 = 20 Marks**

1. Define the basic principle of pipelining.
2. List the difference between RISC and CISC.
3. Draw the instruction cycle state transition diagram.
4. Define program counter.
5. Define stack and its operations.
6. What is meant by hardwired control?
7. List the difference between the little endian and the big endian address assignment schemes.
8. Define latency and throughput.
9. Define subroutines.
10. Find the effective address, if the addressing mode of the instruction is base with index and displacement mode. [Base register = 2000, Index register = 60 with scale factor of 2 and displacement is 200].

**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 IA-32 registers and its instruction set.
13. Explain in detail about timing and control unit with the flow chart for different type of instructions.



**SASTRA**  
Engineering Management & Sciences  
DEEMED TO BE UNIVERSITY

THINK BETTER, THINK STRAIGHT, THINK SASTRA

School of Computing  
Third CIA Test – DEC 2022

Course Code: CSE 212

Course Name: COMPUTER ORGANIZATION &  
ARCHITECTURE

Duration: 90 minutes

Max Marks: 50

**PART A**  
**Answer all the Questions**

**10 x 2 = 20 Marks**

1. Define hazards in Pipelining.
2. What is the Grey code for the decimal numbers 52 and 98?
3. Write the different types of instruction sets in IA-32 processor.
4. Explain cache memories.
5. Solve the Boolean functions, using K-map  $F(x, y, z) = \sum(0, 1, 4, 5)$
6. Write the functions of program controlled I/O.
7. What is Arbitration?
8. Write the basic computer instruction code format.
9. Define vector processing.
10. What is meant by Instruction register?

**PART B**  
**Answer any two Questions**

**2 x 10 = 20 Marks**

11. 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.
12. Explain in detail about the RISC architecture and its addressing modes.
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)



School of Computing  
CIA ITest - September 2022  
Course Code: CSE211  
Course Name: Formal Languages and  
Automata Theory  
Duration: 90 minutes Max Marks: 50

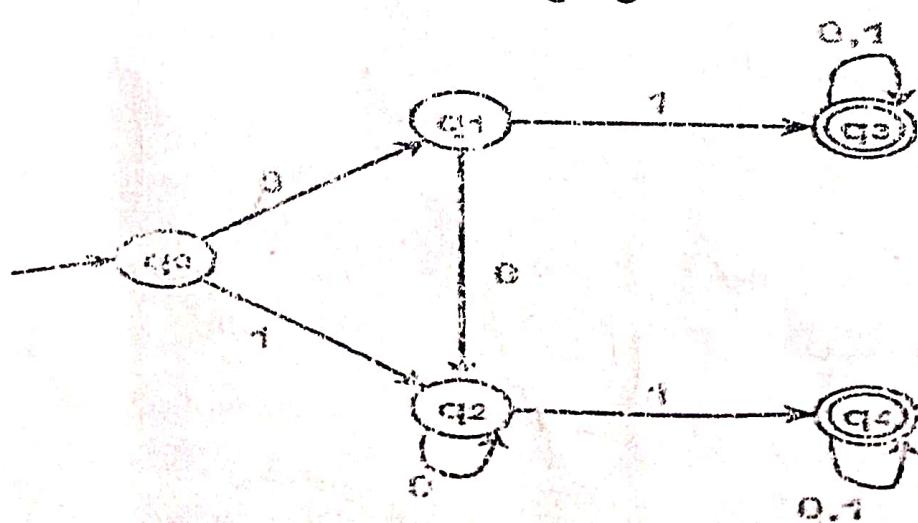
**PART A: Answer all the Questions**  $10 \times 2 = 20$  Marks

1. Draw the abstract model for the electrical circuit with one fan which can be controlled by two switches and a battery.
2. How to categorize the grammar for formal languages based on the restriction of variables and terminals on the left or right side of the production.
3. Construct the DFA for accepting only odd numbers of 0's.
4. Write the Formal definition of Nondeterministic Pushdown Automata.
5. Find the grammar that generates  $L = \{ a^n b^{n+1} : n \geq 0 \}$

Identify the language accepted by the following DFA



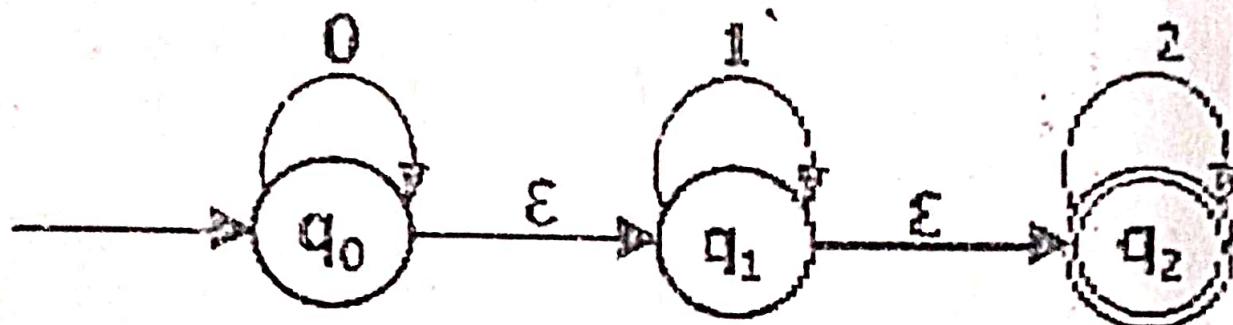
7. Write the formal definition of Pumping Lemma for RL.
8. State any four closure properties of Regular languages.
9. Identify the equivalence states of following DFA for the initial iteration using the table filling algorithm.



10. Construct the equivalent minimized DFA for the DFA given in question no. 9.

**PART B: Answer all questions  $3 \times 10 = 30$  Marks**

- 11 Convert the following e-NFA into its equivalent DFA. Construct the e-NFA transition table and its equivalent DFA transition table. Check the DFA transition procedure for the string 00111222.



- 12 Draw the DFAs for the inputs 0, ε, and char a. With necessary steps convert the following Regular Expression into its equivalent e-NFA.

$$(0+1)^*1(0+1)$$

- 13 Can you use the pumping lemma to prove that the given language is Regular Language? Justify your answer. Using pumping lemma for RL, prove that the  $L = \{a^n b^m c^n : n \geq 1\}$  is not a regular language.

— Best Wishes —



**SASTRA**  
DEEMED TO BE UNIVERSITY

TRANSPARENCY · INTEGRITY · INNOVATION

School of Computing  
CIA II Test – October 2022

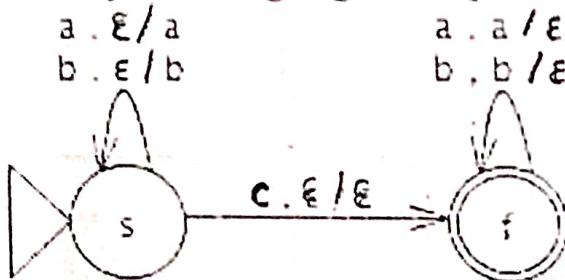
Course Code: CSE211

Course Name: Formal Languages and  
Automata Theory

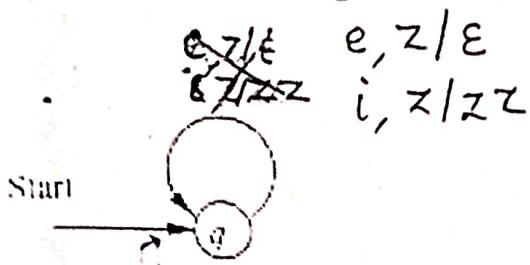
Duration: 90 minutes Max Marks: 50

**PART A: Answer all the Questions** **10 x 2 = 20 Marks**

1. List out the applications of Context-Free Grammar.
2. Construct the CFG for generating palindrome strings of 0s and 1s.
3. Distinguish derivation and Recursive inference in CFG.
4. Define Parse Tree.
5. Identify the language accepted by the following PDA



6. Convert the following PDA to a CFG



7. Remove the unit productions from the following grammar  
 $S \rightarrow Aa/B/c, B \rightarrow A/bb, A \rightarrow a/bc/B$
8. Identify the language generated by the following grammar and its type.  
 $S \rightarrow AB, A \rightarrow aAb, bB \rightarrow bbbB, aAb \rightarrow aa, B \rightarrow e$
9. Turing Machine is the most powerful automata- Justify
10. Construct a Turing machine for accepting only odd number of zeros.

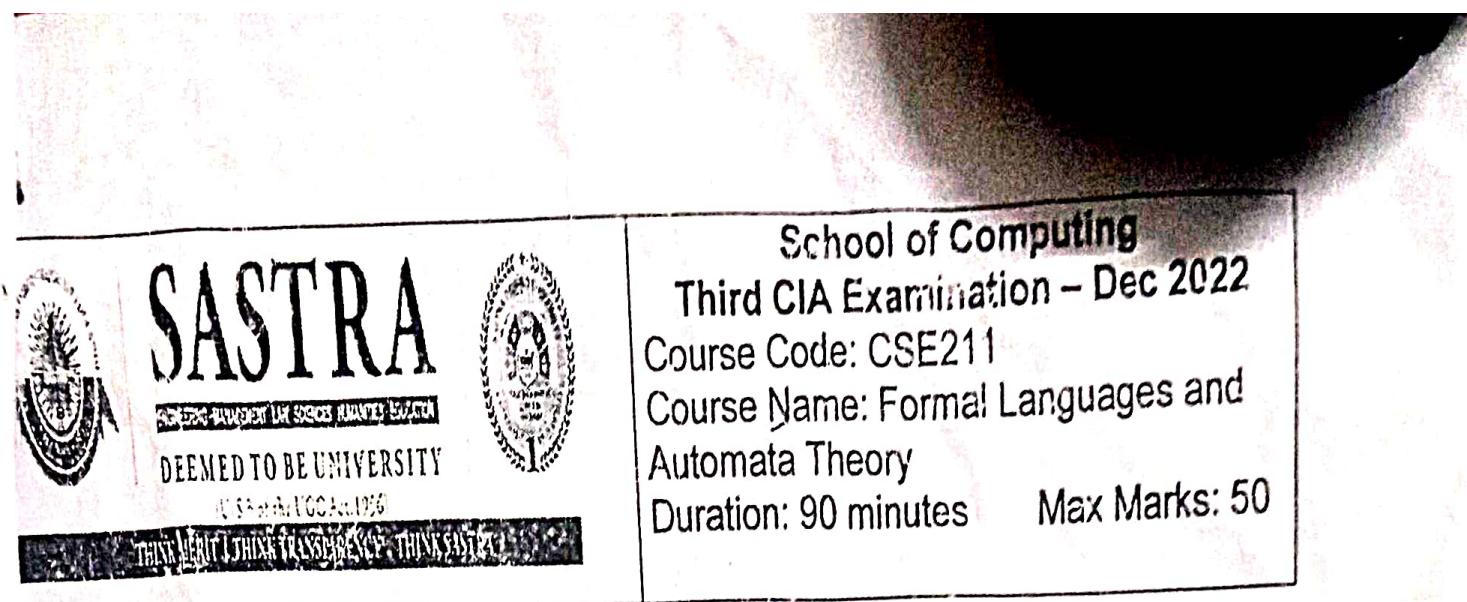
## PART B: Answer any 3 questions $3 \times 10 = 30$ Marks

- 11 Prove that the grammar

$$\begin{aligned} G = \{ & S - AB / C, \\ & A - aAb / ab, \\ & B - cBd / cd, \\ & C - aCd / aDd, \\ & D - bDc / bc \\ & S - A / B, \\ & A - aAb / ab, \\ & B - abB / \epsilon \} \end{aligned}$$

is ambiguous grammar. Prove by derivation and by derivation trees.

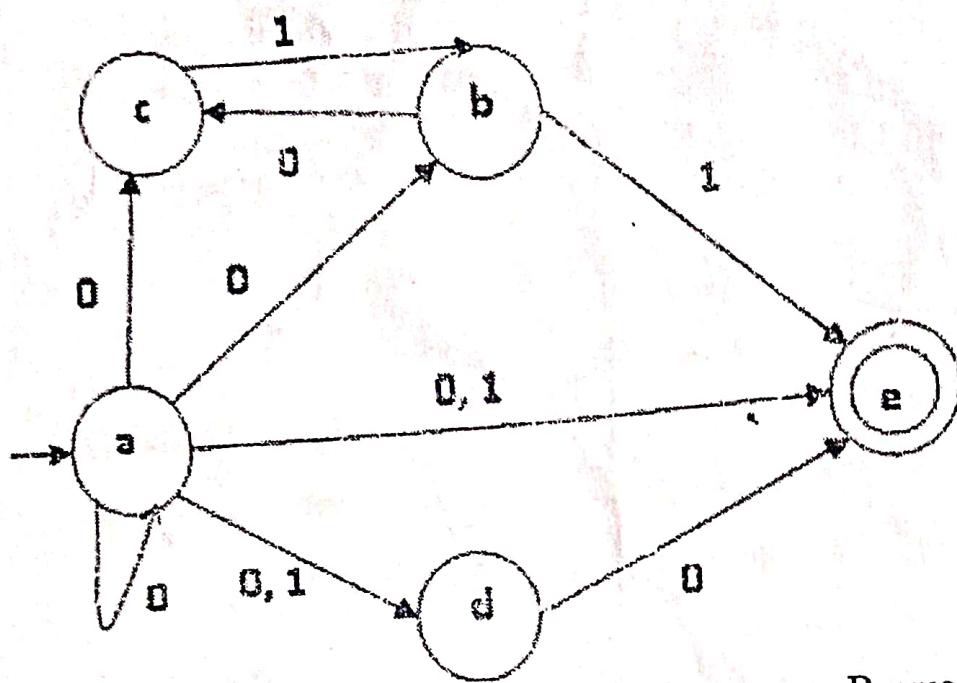
- 12 Write the definitions for Chomsky and Greibach normal forms. Convert the grammar  $G = \{ S \rightarrow ABa, A \rightarrow aab, A \rightarrow Ac \}$  into its equivalent Chomsky Normal Form (CNF).
- 13 Construct a Turing Machine for accepting the language  $L = \{a^n b^n c^n : n > 0\}$ . The minimal string accepted by the TM is "abc". The number of a, b, and c in the input string should be equal and the sample input strings are "aabbcc", "aaabbbccc", and "aaaabbbbcccc". Any other form of input string should be rejected by your TM. Write the step-by-step procedure for construction. Draw the transition diagram and transition table for the TM. Validate the TM design with the string "aabbcc".
- 14 Construct a TM machine for checking the palindrome of the string of 0s and 1s and of even length. Draw the transition diagram and validate the string 011110 with your transition functions.

**PART A (Answer all questions)****10 x 2 = 20 Marks**

1. List out the applications of Context-Free Grammar.
2. Construct the CFG for generating palindrome strings of 0s and 1s.
3. Distinguish derivation and Recursive inference in CFG.
4. Construct a derivation tree for which yields abbbb using the productions  $S \rightarrow aAB$ ,  $A \rightarrow bBb$ ,  $B \rightarrow A/\lambda$
5. Construct an npda that accepts the language generated by the grammar  $S \rightarrow aSSS/aB$ ;  $B \rightarrow b$
6. Write the formal definition of Turing Machine
7. Distinguish between recursive languages and recursively enumerable languages
8. Draw the Chomsky hierarchy of formal languages
9. Let  $A = \{001, 0011, 11, 101\}$  and  $B = \{01, 111, 111, 010\}$ . Does the pair  $\{A, B\}$  have post correspondence solution? How?
10. List the three basic functions that are used to build complicated functions

**PART B (Answer any two questions)****10 x 2 = 20 Marks**

11. Convert the following Non deterministic Finite Automata into Deterministic Finite Automata. Also construct the minimized DFA for the converted DFA.



- 12 Define Pumping Lemma for Regular language. Prove by contradiction the language  $L = \{0^n 1^n \mid n \geq 1\}$  is not a Regular language. Is the above language accepted by a finite automaton? Justify your answer.
- 13 Design primitive recursive functions to implement addition and multiplication two integers x and y. Using these definitions prove that  $4+3=7$  and  $4*3=12$ .

**PART C (Answer all questions)**

**10 x 1 = 10 Marks**

14. Consider the language  $L = \{a^n b^n : n \geq 0\}$ . Design a PDA and a Turing Machine (TM) that accepts the language.