

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Theory | | | | | |
|-------------------------|---|--------|---|---|-------|-----|-------------|
| | | Credit | | | Marks | | |
| RDBMS | MAI-201 | L | T | J | EST | CAT | Total |
| | | | | 3 | 1 | 0 | 80 |
| Course Objective | The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS. | | | | | | |
| Units | Contents (<i>Theory</i>) | | | | | | Hours /week |
| I | Introduction: Advantage of DBMS approach, various view of data, data independence, schema and subschema, primary concepts of data models, Database languages, transaction management, Database administrator and users, data dictionary, overall system architecture. ER model: basic concepts, design issues, mapping constraint, keys, ER diagram, weak and strong entity sets, specialization and generalization, aggregation, inheritance, design of ER schema, reduction of ER schema to tables. | | | | | | 8 |
| II | Domains, Relations and Keys: domains, relations, kind of relations, relational database, various types of keys, candidate, primary, alternate and foreign keys. Relational Algebra & SQL: Features of good relational database design, Codd's rule, structure, relational algebra with extended operations, modifications of Database, basic structure of SQL, set operations, aggregate functions, null values, nested sub queries, derived relations, views, join relations, DDL in SQL. PL/SQL programming: working with stored procedures, triggers, cursor Database Integrity: general idea. Integrity rules, domain rules, attribute rules, relation rules, Database rules, assertions, triggers, integrity and SQL. | | | | | | 8 |
| III | Functional Dependencies and Normalization: basic definitions, trivial and non-trivial dependencies, closure set of dependencies and of attributes, irreducible set of dependencies, introduction to normalization, non-loss decomposition, FD diagram, first, second, third Normal forms, dependency preservation, BCNF, multi-valued dependencies and fourth normal form, Join dependency and fifth normal form. | | | | | | 8 |
| IV | Transaction, concurrency and Recovery: basic concepts, ACID properties, Transaction states, implementation of atomicity and durability, concurrent executions, basic idea of serializability, basic idea of concurrency control, | | | | | | 8 |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| | | |
|---|---|---|
| | <p>basic idea of deadlock, failure classification, storage structure types, stable storage implementation, data access, recovery and atomicity- log based recovery, deferred Database modification, immediate Database modification, checkpoints. Distributed Database: basic idea, distributed data storage, data replication, data fragmentation: horizontal, vertical and mixed fragmentation.</p> | |
| V | <p>Emerging Fields in DBMS: object oriented Databases-basic idea and the model, object structure, object class, inheritance, multiple inheritance, object identity, data warehousing- terminology, definitions, characteristics, data mining and it's overview, Database on www, multimedia Databases-difference with conventional DBMS, issues, similarity based retrieval, continuous media data, multimedia data formats, video servers. Storage structure and file organizations: overview of physical storage media, magnetic disk performance and optimization, basic idea of RAID, file organization, organization of records in files, basic concepts of indexing, ordered indices, basic idea of B-tree and B+-tree organization Network and hierarchical models: basic idea, data structure diagrams, DBTG model, implementations, tree structure diagram, implementation techniques, comparison of the three models.</p> | 8 |

Text Books/ References Book:-

| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
|--|-------------------------------------|---------|-----------------------|
| A Silberschatz, H.F Korth, Sudersan | Database System Concepts | VI | MGH Publication |
| C.J Date | An introduction to Database Systems | VI | Addison-Wesley |
| Elmasri & Navathe | Fundamentals of Database systems | VII | Pearson |
| Raghurama Krishnan | Database Systems | III | TMH |

COURSE OUTCOMES: Students will be able to

| | |
|-----|---|
| CO1 | Learn various views of data, ER model and mapping constraints. |
| CO2 | Create various keys used in SQL and know integrity rules. |
| CO3 | Know functional dependencies and normalization process. |
| CO4 | Learn ACID properties and deal lock process. |
| CO5 | Learn object oriented databases and various file organization mechanisms. |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Theory | | | | | |
|------------------------------------|---|--------|---|---|-------|-----|-------------|
| | | Credit | | | Marks | | |
| Object Oriented Methodology in C++ | MAI-202 | L | T | J | EST | CAT | Total |
| | | | | 3 | 1 | 0 | 80 |
| Course Objective | The objective of this course is learning about the concepts of object oriented methodology and their implementation using C++. | | | | | | |
| Units | Contents (<i>Theory</i>) | | | | | | Hours /week |
| I | Evolution of OOP, OOP Paradigm, advantages of OOP, Comparison between Functional Programming and OOP Approach, Characteristics of Object Oriented Language – Objects, Classes, Inheritance, Reusability, User Defined Data Types, Polymorphism, Overloading. Introduction to C++, Identifier and Keywords, Constants, C++ Operators, Type Conversion, Variable Declaration, Statements, Expressions, Features of Iostream.h and Iomanip.h Input and Output, Conditional Expression Loop Statements, Breaking Control Statements. | | | | | | 8 |
| II | Programming Constructs: Input output statements: cin, cout, comments, escape sequence, manipulators, type conversion, operators, and library functions. Control statements, Structures, Enumeration, Functions, passing arguments to functions, reference arguments, overloaded functions, inline functions, default arguments, variables and storage class and returning by reference, Arrays and Strings. | | | | | | 8 |
| III | Classes & Operator Overloading: Objects and Classes, defining class, c++ objects as physical objects, c++ objects and data types, object as function argument, constructors, as function argument, overloaded constructors, copy constructors, returning objects from functions, this pointer, structures and classes, static class data, static functions, friend functions, const and classes, array of objects. Overloading unary and binary operator, Data conversions (built-in & user defined data types). | | | | | | 8 |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

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|-----------|---|---|
| IV | Inheritance & Virtual Functions: Inheritance concept, derived class and base class, derived class constructors, overloading member functions, class hierarchies, public, private & protected inheritance, levels of inheritance, multiple inheritance, Virtual Inheritance, new and delete operator. Early & late binding, Virtual functions. | 8 |
| V | Files I/O & Generic Programming: Using istream/ostream member functions, Understanding implementation of Files, Writing and Reading Objects. Exception Handling: types of exceptions, try, throw, catch block. Templates: types and concepts of generic programming. | 8 |

Text Books/ References Book:-

| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
|------------------------|--|----------------|------------------------------|
| Bjarne Stroustrup | The C++ Programming Language | IIIrd | Addision Wesley |
| Herbert Schildt, | “C++ The Complete Reference”, McGraw Hill | | McGraw Hill |
| D. Ravichandran, | Programming with C++ | | Tata Mcgraw Hill |
| E. Balagursamy | Object Oriented Programming using C ++ | | Tata McGraw Hill. |

COURSE OUTCOMES: Students will be able to

| | |
|-----|--|
| CO1 | Describe object oriented programming approach and various header files. |
| CO2 | Learn and implement control structures and inline function. |
| CO3 | Learn and implement constructors and type conversion mechanisms. |
| CO4 | Understand and implement various inheritance methods & usage of virtual functions. |
| CO5 | Learn exception handling mechanisms and reading & writing into files. |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Theory | | | | | |
|---|--|--------|---|---|-------|-----|-------------|
| | | Credit | | | Marks | | |
| Probabilistic Modelling and Reasoning with Python | MAI-203 | L | T | J | EST | CAT | Total |
| | | 3 | 1 | 0 | 80 | 20 | 100 |
| Course Objective | The objective of this course is to teach students the basic concepts of Statistics, Probability and probability distribution and other statistical methods to solve various engineering problems | | | | | | |
| Units | Contents (<i>Theory</i>) | | | | | | Hours /week |
| I | <p>Introduction to Statistics: Role of statistics in scientific methods, current applications of statistics. Scientific data gathering: Sampling techniques, scientific studies, observational studies, data management.</p> <p>Data description: Displaying data on a single variable (graphical methods, measure of central tendency, measure of spread), displaying relationship between two or more variables, measure of association between two or more variables.</p> | | | | | | 8 |
| II | <p>Probability Theory: Sample space and events, probability, axioms of probability, independent events, conditional probability, Bayes' theorem.</p> <p>Random Variables: Discrete and continuous random variables. Probability distribution of discrete random variables, binomial distribution, poisson distribution. Probability distribution of continuous random variables, The uniform distribution, normal (gaussian) distribution, exponential distribution, gamma distribution, beta distribution, t-distribution, distribution. Expectations, variance and covariance. Probability Inequalities. Bivariate distributions</p> | | | | | | 8 |
| III | <p>Point Estimations: Methods of finding estimators, method of moments, maximum likelihood estimators, bayes estimators. Methods of evaluating estimators, mean squared error, best unbiased estimator, sufficiency and unbiasedness Interval Estimaton: Confidence interval of means and proportions, Distribution free confidence interval of percentiles</p> | | | | | | 8 |
| IV | <p>Test of Statistical Hypothesis and p-values: Tests about one mean, tests of</p> | | | | | | 8 |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

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| | equality of two means, test about proportions, p-values, likelihood ratio test, Bayesian tests Bayesian Statistics: Bayesian inference of discrete random variable, Bayesian inference of binomial proportion, comparing Bayesian and frequentist inferences of proportion, comparing Bayesian and frequentist inferences of mean | | |
| V | Univariate Statistics using Python: Mean, Mode, Median, Variance, Standard Deviation, Normal Distribution, t-distribution, interval estimation, Hypothesis Testing, Pearson correlation test, ANOVA | 8 | |
| Text Books/ References Book:- | | | |
| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
| Achim Klenke | Probability Theory A Comprehensive Course | Second Edition | Springer |
| Christian Heumann, Michael Schomaker Shalabh | Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R | | Springer International Publishing |
| Douglas C. Montgomery | Applied Statistics and Probability for Engineers | | Wiley India |
| COURSE OUTCOMES: Students will be able to | | | |
| CO1 | Learn data gathering and displaying methods. | | |
| CO2 | Understand sampling theory and Theory of Estimation. | | |
| CO3 | Learn various evaluating estimators. | | |
| CO4 | Understand various tests of Hypothesis and Significance | | |
| CO5 | Learn Correlation and Regression and fitting of different types of curves | | |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Theory | | | | | |
|--|---|--------|---|---|-------|-----|-------------|
| | | Credit | | | Marks | | |
| Software Engineering Methodologies and UML | MAI-204 | L | T | J | EST | CAT | Total |
| | | 3 | 1 | 0 | 80 | 20 | 100 |
| Course Objective | To understand the software engineering methodologies involved in the phases of project development and study of the problem identify project scope, objectives and infrastructure. | | | | | | |
| Units | Contents (<i>Theory</i>) | | | | | | Hours /week |
| I | Software Engineering paradigms – Waterfall Life cycle model – Spiral Model – Prototype Model– Software Requirement - Requirements Elicitation Techniques – Initial Requirements Document — SRS Document – Requirements Change Management - Project Management. | | | | | | 8 |
| II | Software Design Abstraction – Modularity – Software Architecture – Cohesion – Coupling – Various Design Concepts and notations – Development of Detailed Design & Creation of Software Design Document - Dataflow Oriented design – Designing for reuse – Programming standards. | | | | | | 8 |
| III | Scope – Classification of metrics – Measuring Process and Product attributes – Direct and Indirect measures – Reliability – Software Quality Assurance – Standards. Need of Software Estimation – Function Point – Risk Management. | | | | | | 8 |
| IV | Software Testing Fundamentals – Software testing strategies – Black Box Testing – White Box Testing – System Testing – Functional Testing – Structural Testing – Regression Testing - Testing Tools – Test Case Management – Challenges of Software Maintenance – Types of Maintenance. Software Maintenance Organization – Maintenance Report. | | | | | | 8 |
| V | Introduction to UML: Use Case Approach, Identification of Classes and Relationships, Identifying State and Behavior, Use Case Diagram Class Diagram – State Diagram - Sequence Diagram – Activity Diagram – Deployment Diagrams Case Study – LMS. | | | | | | 8 |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Text Books/ References Book:- | | | |
|--|--|----------------|------------------------------|
| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
| R. S. Pressman | Software Engineering – A practitioner’s approach | VI | McGraw Hill |
| Pankaj Jalote | Software Engg | IV | Narosa Publications |
| Ian Sommerville | Software Engineering 6/e | VI | Addison-Wesley |
| COURSE OUTCOMES: Students will be able to | | | |
| CO1 | Understand various models and design SRS document. | | |
| CO2 | Learn modular approach for design software. | | |
| CO3 | Learn measures of software estimation and risk management. | | |
| CO4 | Learn various software testing methods and their usage. | | |
| CO5 | Understand UML and its need in the software development. | | |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Theory | | | | | |
|--|---|--------|---|---|-------|-----|-------------|
| | | Credit | | | Marks | | |
| R programming for Data Science and Data Analysis | MAI-205 | L | T | J | EST | CAT | Total |
| | | | | 3 | 1 | 0 | 80 |
| Course Objective | The objective of this course is to teach students R Programming Language, basic functions in R programming language and critical techniques | | | | | | |
| Units | Contents (<i>Theory</i>) | | | | | | Hours /week |
| I | Getting Started with R and R Workspace: Introducing R, R as a programming Language, the need of R, Installing R, RStudio, RStudio's user interface, console, editor, environment pane, history pane, file pane, plots pane, package pane, help and viewer pane R Workspace, R's working directory, R Project in R Studio, absolute and relative path, Inspecting an Environment, Inspect existing Symbols, View the structure of object, Removing symbols, Modifying Global Options, Modifying warning level, Library of Packages, Getting to know a package, Installing a Package from CRAN, Updating Package from CRAN, Installing package from online repository, Package Function, Masking and name conflicts | | | | | | 8 |
| II | Basic Objects and Basic Expressions: Vectors, Numeric Vectors, Logical Vectors, Character Vectors, subset vectors, Named Vectors, extracting element, converting vector, Arithmetic operators, create Matrix, Naming row and columns, subsetting matrix, matrix operators, creating and subsetting an Array, Creating a List, extracting element from list, subsetting a list, setting value, creating a value of data frame, subsetting a data frame, setting values, factors, useful functions of a data frame, loading and writing data on disk, creating a function, calling a function, dynamic typing, generalizing a function. Assignment Operators, Conditional Expression, using if as expression and statement, using if with vectors, vectorized if: ifelse, using switch, using for loop, nested for loop, while loop | | | | | | 8 |
| III | Working with Basic Objects and Strings: Working with object function, getting | | | | | | 8 |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

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| | data dimensions, reshaping data structures, iterating over one dimension, logical operators, logical functions, dealing with missing values, logical coercion, math function, number rounding functions, trigonometric functions, hyperbolic functions, extreme functions, finding roots, derivatives and integration, Statistical function, sampling from a vector, | |
| IV | Working with random distributions, computing summary statistics, covariance and correlation matrix, printing string, concatenating string, transforming text, Formatting text, formatting date and time, formatting date and time to string, finding string pattern, using group to extract data, reading data | 8 |
| V | Working with Data – Visualize and Analyze Data: Reading and Writing Data, importing data using built-in-function, READR package, export a data frame to file, reading and writing Excel worksheets, reading and writing native data files, loading built-in data sets, create scatter plot, bar chart, pie chart, histogram and density plots, box plot, fitting linear model and regression tree. | 8 |

Text Books/ References Book:-

| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
|-----------------------------------|-----------------------------|---------|-----------------------|
| Garrett Golemund | Hands-On Programming with R | | |
| Hadley Wickham & Garrett Golemund | R for Data Science | | |

COURSE OUTCOMES: Students will be able to

| | |
|-----|--|
| CO1 | Understand RStudio and its concepts. |
| CO2 | Learn vectors and control instructions. |
| CO3 | Learn and implement logical operators and functions. |
| CO4 | Learn covariance and correlation matrix. |
| CO5 | Learn read and write data into and from the file. |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Theory | | | | | |
|-------------------------|--|--------|---|---|-------|-----|-------------|
| | | Credit | | | Marks | | |
| Data Structures | MAI-206 | L | T | J | EST | CAT | Total |
| | | | | 3 | 1 | 0 | 80 |
| Course Objective | The goal of this course is to bring out the importance of data structures in a variety of applications. | | | | | | |
| Units | Contents (<i>Theory</i>) | | | | | | Hours /week |
| I | Stack and Queue: contiguous implementations of stack, various operations on stack, various polish notations-infix, prefix, postfix, conversion from one to another-using stack; evaluation of post and prefix expressions. Contiguous implementation of queue: Linear queue, its drawback; circular queue; various operations on queue; linked implementation of stack and queue operations | | | | | | 8 |
| II | General List: list and it's contiguous implementation, it's drawback; singly linked list-operations on it; doubly linked list-operations on it; circular linked list; linked list using arrays. | | | | | | 8 |
| III | Trees: definitions -height, depth, order, degree, parent and child relationship etc; Binary Trees: various theorems, complete binary tree, almost complete binary tree; Tree traversals -preorder, in order and post order traversals, their recursive and non -recursive implementations; expression tree - evaluation; linked representation of binary tree -operations. Threaded binary trees; forests, conversion of forest into tree. Heap-definition. | | | | | | 8 |
| IV | Searching, Hashing and Sorting: requirements of a search algorithm; sequential search, binary search, indexed sequential search, interpolation search; hashing-basics, methods, collision, resolution of collision, chaining; Internal sorting- Bubble sort, selection sort, insertion sort, quick sort, merge sort on linked and contiguous list, shell sort, heap sort, tree sort. | | | | | | 8 |
| V | Graphs: related definitions: graph representations- adjacency matrix, adjacency lists, adjacency multilist; traversal schemes- depth first search, breadth first search; Minimum spanning tree; shortest path algorithm; kruskals & dijkstras algorithm. Miscellaneous features Basic idea of AVL tree- definition, insertion | | | | | | 8 |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| | & deletion operations; basic idea of B-tree- definition, order, degree, insertion & deletion operations; B+-Tree- definitions, comparison with B-tree; basic idea of string processing. | | |
|--|---|---------|-----------------------|
| Text Books/ References Book:- | | | |
| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
| Kruse R.L | Data Structures and Program Design in C | II | PHI |
| Trembly | Introduction to Data Structure with Applications | IV | |
| Tennenbaum A.M & others | Data Structures using C & C++ | III | PHI |
| Mark Allen Addison Wesley | Data structure and Algorithm Analysis in C Weiss | | |
| COURSE OUTCOMES: Students will be able to | | | |
| CO1 | Describe, explain and use abstract data types including stacks, queues and lists | | |
| CO2 | Implement single and doubly linked list. | | |
| CO3 | Design and create tree data structures for storing and retrieving data. | | |
| CO4 | Design programs for various searching and sorting data. | | |
| CO5 | Learn and implement graph traversal schemes and graph representations. | | |

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Practical | | | | |
|------------------------|------------|-----------|---|-------|-----|-------|
| | | Credit | | Marks | | |
| Programming Lab in C++ | MAI-207 | P | J | ESP | CAP | Total |
| | | 8 | 0 | 120 | 80 | 200 |

Content:

1. Simple C++ programs to implement various control structures.
 - if statement
 - switch case statement and do while loop
 - for loop
 - while loop
 - Array
2. Write a program Illustrating Class Declarations, Definition, and Accessing Class Members
3. Write a C++ Program to illustrate default constructor, parameterized constructor and copy constructors
4. WAP to find the largest of three numbers using inline function.
5. Given that an EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary and print data members.
6. Write a C++ program to read the data of N employee and compute Net salary of each employee (DA=52% of Basic and Income Tax (IT) =30% of the gross salary).
7. Write a C++ Program to display Names, Roll No., and grades of 3 students who have appeared in the examination. Declare the class of name, Roll No. and grade. Create an array of class objects. Read and display the contents of the array.
8. WAP to Illustrate Multilevel Inheritance.
9. WAP to Demonstrate Multiple Inheritances.
10. Write a Program to demonstrate friend function and friend class.
11. Write a C++ to illustrate the concepts of console I/O operations.
12. Write a C++ program to use scope resolution operator. Display the various values of the same variables declared at different scope levels.
13. Write a Program to illustrate New and Delete Keywords for dynamic memory allocation
14. Write a C++ program to allocate memory using new operator.
15. WAP to demonstrate template class
16. WAP to demonstrate template function.

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Practical | | | | |
|---------------|------------|-----------|---|-------|-----|-------|
| | | Credit | | Marks | | |
| RDBMS Lab | MAI-208 | P | J | ESP | CAP | Total |
| | | 2 | 0 | 30 | 20 | 50 |

Contents:

Create the following Databases.

Salesmen

SNUM SNAME CITY COMMISSION

1001 Piyush London 12 %
1002 Sejal Surat 13 %
1004 Miti London 11 %
1007 Rajesh Baroda 15 %
1003 Anand New Delhi 10 %

SNUM : A unique number assigned to each salesman.

SNAME : The name of salesman.

CITY : The location of salesmen.

COMMISSION: The Salemen's commission on orders.

Customers

CNUM CNAME CITY RATING SNUM

2001 Harsh London 100 1001
2002 Gita Rome 200 1003
2003 Lalit Surat 200 1002
2004 Guni Bombay 300 1002
2006 Chirag London 100 1001
2008 Chinmay Surat 300 1007
2007 Pratik Rome 100 1004

CNUM : A unique number assigned to each customer.

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

CNAME : The name of the customer.

CITY : The location of the customer.

RATING : A level of preference indicator given to this customer.

SNUM : The number of salesman assigned to this customer.

Orders

ONUM AMOUNT ODATE CNUM SNUM

```
-----  
3001  18.69  10/03/97    2008  1007  
3003  767.19      10/03/97    2001  1001  
3002  1900.10 10/03/97    2007  1004  
3005  5160.45 10/03/97    2003  1002  
3006  1098.16 10/03/97    2008  1007  
3009  1713.23 10/04/97    2002  1003  
3007   75.75  10/04/97    2004  1002  
3008  4723.00 10/05/97    2006  1001  
3010  1309.95 10/06/97    2004  1002  
3011  9891.88 10/06/97    2006  1001
```

ONUM : A unique number assigned to each order.

AMOUNT : The amount of an order.

ODATE : The date of an order.

CNUM : The number of customer making the order.

SNUM : The number of salesman credited with the sale.

Write queries :-

1. Produce the order no, amount and date of all orders.
2. Give all the information about all the customers with salesman number 1001.
3. Display the following information in the order of city, sname, snum and commission.
4. List of rating followed by the name of each customer in Surat.
5. List of snum of all salesmen with orders in order table without any duplicates.
6. List of all orders for more than Rs. 1000.
7. List of names and cities of all salesmen in London with commission above 10%.
8. List all customers whose names begins with a letter 'C'.
9. List all customers whose names begins with letter 'A' to 'G'.
10. List all orders with zero or NULL amount.
11. Find out the largest orders of salesman 1002 and 1007.

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

12. Count all orders of October 3, 1997.
13. Calculate the total amount ordered.
14. Calculate the average amount ordered.
15. Count the no. of salesmen currently having orders.
16. List all salesmen with their % of commission.
17. Assume each salesperson has a 12% commission. Write a query on the order table that will produce the order number, salesman no and the amount of commission for that order.
18. Find the highest rating in each city in the form : For the city (city), the highest rating is : (rating)
19. List all in descending order of rating.
20. Calculate the total of orders for each day and place the result in descending order.
21. Show the name of all customers with their salesman's name.
22. List all customers and salesmen who shared a same city.

LNCT UNIVERSITY, BHOPAL

Programme:- MCA (AI/ML)

Semester - II

wef: July 2022

| Name of Paper | Paper Code | Practical | | | | |
|----------------------------------|------------|-----------|---|-------|-----|-------|
| | | Credit | | Marks | | |
| Mini Project in R Programming | MAI-209 | P | J | ESP | CAP | Total |
| | | 0 | 2 | 30 | 20 | 50 |

Design a project using R programming to fulfill the requirements of any organization or firm.