DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

DATA STRUCTURES

Subject Code: **L-T-P: 3:0:0**

Total Hours : 45 **Credits: 3**

Prerequisite : Problem solving through Programing

Course Learning Objectives (CLO)

The objective of this course is to make students to

The objective of the course is to introduce the fundamental concept of data structures and develop skills to apply appropriate algorithms in problem solving.

UNIT 1: **[10 hours]**

Arrays: array initialization: static and dynamic, bound checking, 2D array, initialization of 2D array.

Pointers: representation, initialization, operators, operations.

Function: What is function, passing arguments to function, passing arguments by value, returning value, passing arguments by reference, scope rule of function, recursion, storage classes and scope, library functions like math library, recursion.

UNIT 2: **[10 hours]**

Dynamic memory allocation: types of memory allocation: malloc(), calloc(), realloc () and free ().

Introduction to data structure – primitive and non-primitive

Linked list [singly and doubly]- representation and implementation, operations, applications.

UNIT 3: **[08 hours]**

Stack – representation and implementation [array and linked list], operations, applications.

UNIT 4: **[08 hours]**

Queue – representation and implementation [array and linked list], operations, type of queues, applications.

UNIT 5: **[09 hours]**

Tree: type of trees: - Binary Tree and Binary Search Tree.

Binary tree and Binary Search Tree- representation and implementation, operations, applications.

Introduction to graph – types of graphs and their representation, Minimum spanning tree and Single source shortest path.

Mini-Project

To build an application with visualization that can demonstrate the working principle of different data structures.

TEXT BOOK

1. "Data Structure using C", Aaron M. Tenenbaum, Yedidyah Langsam & Moshe J. Augenstein, Pearson Education/PHI, 2019.
2. "Data structures and program design in C", 2nd Edition, Robert Kruse.
3. "Data Structures and Algorithm Analysis in C++", Mark Allen Weiss, Third Edition, Pearson Education, 2007

REFERENCE BOOK

1. "Introduction to Data Structures in C", Kamthane. Pearson Education 2005.
2. "An Introduction to Data Structures with Application ", Trembley and Sorenson, 2nd Edition, MCrawHill, 2004.
3. "Understanding Pointers In C", 4th edition, Yashavant P. Kanetkar
4. "Data structures: A pseducode approach with C", 2nd edition Richard F Gillberg & Behrouz A Frouzan.

OUTCOMES

On completion of the course, students are expected to:

CO 1 Discuss the concepts and operations of arrays, pointers and functions.

CO 2 Demonstrate the different memory allocation functions.

CO 3 Demonstrate the implementation of different types of data structures and their operations on linked list

CO 4 Demonstrate the different operations and applications of stack and queues.

CO 5 Describe the different operations and applications of nonlinear data structure.

CO 6 Develop a mini project by understanding the essential data structure concepts.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Program Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1			1							
CO2	3	2	1		1							
CO3	3	2	1		2							
CO4	3	2	1		2							
CO5	2	1			2							
CO6				3	3	2	2	2	2	2	2	2

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

FUNDAMENTALS OF BUSINESS MANAGEMENT

Subject Code: **L-T-P: 3:0:0**

Total Hours: 45 **Credits: 3**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Introduce the core concepts of Finance and understand fundamental concepts of financial accounting in a management context.
2. Develop the skills to create carefully planned and confidently delivered emails- presentations- action plans- and other key business communications.
3. Review key mathematics concepts to solve quantitative business problems.
4. Introduce statistics from the management perspective with emphasis on developing the skills needed to make good decisions and become a more effective manager.
5. Learn and apply shortcuts and tips for mastering the functions in Excel.

UNIT 1: Introduction to Financial Accounting **[08 hours]**

Asset management - Capital structure - Cross-functional management - Decision making- Financial markets - Financial ratios- Risk management – Valuation – Financial Statements – Income Statements - Financial performance measurement - Management accounting.

UNIT 2: Management Communication **[09 hours]**

Business communication- Business writing- Communication formats- Communication media- Communication skills- Communication strategy- Communication styles- Making presentations- Management communication- Nonverbal communication- Persuasion- Written communications.

UNIT 3: Math for Management **[10 hours]**

Accounting- Decision making- Finance- Probability- Quantitative analysis – Calculus - Summation Notation - Covariance and Correlation – Payback, NPV, IRR and CAGR – Option Pricing.

UNIT 4: Quantitative Methods **[09 hours]**

Decision analysis - Decision tree- Project management- Quantitative analysis- Regression analysis- Statistical analysis- Strategic analysis- Value of information.

UNIT 5: Spreadsheet Modelling **[09 hours]**

Data processing- Decision making- Finance- Financial performance measurement- General management- Spreadsheet modeling

TEXTBOOKS:

1. David Annand, Athabasca University; Henry Dauderis – "Introduction to Financial Accounting" - Copyright Year: 2017, Last Update: 2021, Publisher: Lyryx
2. "Business Communication for Success" - Publisher: University of Minnesota Libraries Publishing, Copyright Year: 2015
3. Paolo Brandimarte - "Quantitative Methods: An Introduction for Business Management" - Copyright © 2011 John Wiley & Sons, Inc. - published:4 April 2011
4. Kenneth R. Baker – "Optimization Modeling with Spreadsheets" Second Edition - Copyright © 2011 John Wiley & Sons, Inc.- Published:7 March 2011

REFERENCES:

1. Jerry J. Weygandt, Donald E. Kieso, Paul D. Kimmel – "Financial Accounting" - 10th Edition - December 2016
2. Arthur H. Bell, Dayle M. Smith - "Management Communication" - 3rd Edition - December 2009
3. Stephen G. Powell, Kenneth R. Baker - "Business Analytics: The Art of Modeling With Spreadsheets, 5th Edition" - October 2016

Course Outcomes:

On completion of this course, students are able to

CO 1 Explain relationship between components of financial statements used to describe a business.

CO 2 Demonstrate the knowledge of framing financial statements and compute simple ratios to capture key elements of a firm's performance.

CO 3 Use fundamental concepts in business communication, including planning, writing, presenting and executing successful business communication strategies.

CO 4 Solve quantitative problems by reviewing key mathematics concepts.

CO 5 Discuss how to analyse quantitative information and make better business decisions.

CO 6 Create spreadsheet models to solve business problems.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Programme Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1										
CO2	3	2	1	2	1							
CO3	3	2	1	2	2							
CO4	3	2	1	2	3							
CO5	2	1		2	3							
CO6	3	3	3	2	3							

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

DISCRETE MATHEMATICS AND GRAPH THEORY

Subject Code: **L-T-P: 3:0:0**

Total Hours: 45 **Credits: 3**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Understand the Mathematical structures and operations.
2. Understand the principles used in the analysis of Algorithms.
3. Discuss the concepts associated permutations, combinations and their applications
4. Discuss the concepts and terminologies associated with graph theory
5. Describe recurrence relations and the methods to find out their solutions.

UNIT 1: Basic Structures: Sets, Relations and Functions [10 hours]

Sets: Methods for describing a set, Venn diagrams, Union, intersection, set difference, complement, Cartesian product, Power sets, Cardinality of finite sets. Relations: Reflexivity, symmetry, antisymmetry, transitivity, Equivalence relations, partial orders. Functions: Functions, Domain, target, and range/image of a function, Surjections, injections, bijections, Inverses, Composition

UNIT 2: Fundamental Principles of Counting: **[08 hours]**

Basics of Counting: The Sum Rule, the Product Rule, Permutations, Combinations: The Binomial Theorem, Combinations with Repetition, Pigeonhole Principle.

UNIT 3: Principles of Inclusion and Exclusion: [08 hours]

The Principle of Inclusion Exclusion, The Generalizations of the Principles, Derangements – Nothing is in its Right Place, Rook Polynomials, Arrangements with Forbidden Positions.

UNIT 4: Generating Functions and Recurrence Relations: [10 hours]

Generating Functions: Introductory Examples, Definition & Examples: Calculational Techniques, Partitions of Integers, The Exponential Generating Functions, and the Summation Operator. **Recurrence Relations**: The First - Order Linear Recurrence Relation, The Second - Order Linear Homogeneous Recurrence Relations with Constant Coefficients, The Non-Homogeneous Recurrence Relations, The Method of Generating Functions.

UNIT 5: Introduction to Graph Theory **[09 hours]**

Definitions and Examples, Sub graphs, Complements and Graph Isomorphism, Vertex degree: Euler Trails and Circuits, Planar Graphs, Hamilton Paths and Cycles, Graph Colouring, Chromatic Polynomials

TEXTBOOKS:

1. Discrete Mathematics and it's Applications by Kenneth Rosen, Tata McGraw Hill (Seventh edition),2012
2. Elements of Discrete Mathematics by C. L. Liu and D. P. Mohapatra, Tata McGraw Hill (fourth edition), 2013

REFERENCES :

1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.

Course Outcomes:

On completion of this course, students are able to

CO1: Demonstrate critical thinking, analytical reasoning, and problem-solving skills

CO2: Use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems

CO3: Identify a problem and analyse it in terms of its significant parts and the information needed to solve it

CO4: Demonstrate the formulation and evaluation of possible solutions to problems, select and defend the chosen solutions

CO5: Construct graphs and charts, interpret them, and draw appropriate conclusions

CO6: Employ functions and recurrence relations for the pattern identified in the numbers and the functions

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Programme Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	1	1							
CO2	3	2	1		1							
CO3	2	1			2							
CO4	3	2	1	1	2							
CO5	3	3	3	2	2							
CO6	3	2	1	1	2							

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

PROGRAMMING IN JAVA

Subject Code: **L-T-P: 3:0:0**

Total Hours: 45 **Credits: 3**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Understand Object Oriented Programming concepts and basic characteristics of Java.
2. Know the principles of packages, inheritance and interfaces
3. Explore exception handling mechanisms and to develop applications using threads
4. Explore exception handling mechanisms and to develop applications using threads
5. Develop applications using JDBC connectivity

UNIT 1: Object Oriented Programming Concepts **[09 hours]**

OOP Concepts: Review of Object-oriented concepts: Encapsulation, Polymorphism and Inheritance, Objects and Classes, Introduction to Java: History of Java, Java buzzwords, JVM architecture, Data types, Variables, Arrays, control and looping statements, Classes, Methods and Constructors in Java

UNIT 2: Inheritance, Packages & Collection Framework: **[09 hours]**

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces, Inner classes. Packages: Creating and Importing packages.

Collection Framework: Collections overview, Collection Interfaces, The Collection classes. The Legacy Classes and Interfaces- Dictionary, Hash table ,Properties, Stack, Vector More Utility classes, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner

UNIT 3: Exceptions & Multithreading **[08 hours]**

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating user defined exceptions. **Multithreading**: Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication

UNIT 4: Event Driven Programming **[09 hours]**

Graphics programming - Frame – Components - working with 2D shapes - Using colour, fonts, and images, Basics of event handling - event handlers - adapter classes – action events, item events, mouse events, key events, , window events, AWT event hierarchy , Swings: Introduction to Swings, Hierarchy of swing components. Containers, Top level containers - JFrame, JWindow, JDialog,

JPanel, JButton, JToggle Button, JCheckBox, JRadioButton, JLabel,JTextField, JTextArea, JList, JComboBox, JScrollPane

UNIT 5: JDBC **[10 hours]**

The Concept of JDBC, JDBC Driver Types, JDBC Packages, A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Result Set; Transaction Processing; Metadata, Data types; Exceptions.

Mini-Project

1. To build an Android application for managing contacts using Android Studio, Java and SQLite3.
2. To build a simple, fun, interactive brain training android game (Cognitive Games using Java).
3. To Develop a Java GUI application to implement the Breakout Ball Game

TEXTBOOKS:

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011
2. Jim Keogh :J2EE - The Complete Reference –Tata McGraw Hill, 2007.

Course Outcomes:

On completion of this course, students are able to

CO 1 Describe the concepts of Object-Oriented programming

CO 2 Demonstrate the concepts of inheritance and interfaces through programming

CO 3 Demonstrate exception handling mechanisms through Java applications

CO 4 Demonstrate multithreading with real world examples

CO 5 Examine the event driven programs using swings

CO 6 Test java applications using JDBC connectivity and execute the necessary queries

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			2							
CO2	3	2	1		2							
CO3	3	2	1		2							
CO4	3	2	1		2							
CO5	3	3	2	2	2							
CO6	3	3	2	2	2	2	2	2	2	2	2	2

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

COMPUTER ARCHITECTURE AND ORGANIZATION

Subject Code: **L-T-P: 3:0:0**

Total Hours: 45 **Credits: 3**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Discussion on the various basic concepts and structure of computers
2. Understanding the concepts related to register transfer logic and different arithmetic operations.
3. Detailed explanation on addressing modes and memory organization
4. Exploring and learning various types of serial communication techniques

UNIT 1: Fundamentals and Basics **[10 hours]**

CPU, Memory, Input-Output Subsystems, Control Unit, Functional units, Basic operational concepts, Bus structures, Software, Performance, Multiprocessors and Multi-Computers.

Encoders, Demultiplexers, Programmable Logic Arrays (PLAs), Digital Logic Circuits: Basic Logic Functions, Synthesis of Logic Functions Using AND, OR, and NOT Gates, Minimization of Logic Expression, Synthesis with NAND and NOR Gates, Flip-Flops, Encoders, Demultiplexers.

UNIT 2: Data Representation and Operations **[8 hours]**

Data types, Complements, Other binary codes, Error Detection codes, Register and Micro operations: Register Transfer language, Register Transfer Bus and memory transfers, Arithmetic Micro operations, logic micro operations, Shift micro operations, Arithmetic logic shift unit, Circuits for all micro operations.

UNIT 3: Computer Arithmetic and Processing Unit **[8 hours]**

Addition, subtraction, multiplication and division operations, Floating point Arithmetic operations. Processing Unit: Instruction Codes, Computer Registers, Computer Instructions, Instruction Cycle, Memory Reference Instructions, Addressing modes, Data Transfer and manipulations, RISC, CISC

UNIT 4: Input/output Organization **[9 hours]**

Peripheral Devices, Input Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input-Output Processor, Serial communication

Parallel and Vector Processing: Parallel processing, Pipelining, Arithmetic pipeline, Instruction pipeline, RISC Pipeline, Vector Processing, Array Processors.

UNIT 5: Memory Organization **[10 hours]**

Types of memory, memory hierarchy, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies, Memory management hardware.

TEXTBOOKS:

1. M. Moris Mano, "Computer Systems Architecture", 4th Edition, Pearson/PHI, ISBN:10:0131755633
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 6th Edition, McGraw Hill.
3. David A. Patterson and John L.Hennessy, "Computer Organization and Design: The Hardware/Software Interface",5th Edition, Elsevier.

REFERENCES:

1. John L. Hennessy and David A. Patterson, "Computer Architecture a quantitative approach", 4th Edition Elsevier, ISBN:10:0123704901.
2. William Stallings, "Computer Organization and Architecture", 6th Edition, Pearson/PHI, ISBN:10:0-13-609704-9
3. Donald e Givone, "Digital Principles and Design", TMH. A.Anandkumar, "Fundamentals of digital circuits", 4th Edition, PHI.

Course Outcomes:

On completion of this course, students are able to

CO 1 Discuss the theory, functionality and basic architecture of CPU.

CO 2 Examine of design issues on the basis of speed, technology, cost and performance.

CO 3 Demonstrate the working of a simple CPU by making use of theoretical concepts.

CO 4 Explain the different concepts of parallel processing, pipelining and interprocessor communication.

CO 5 Discuss the I/O and memory organization in a better way.

CO 6 Summarise the different number systems, binary addition and subtraction, 2's complement representation and operations along with-its representation.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Programme Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1										
CO2	2	1										
CO3	3	2	1									
CO4	2	1										
CO5	2	1										
CO6	2	1										

DATA COMMUNICATION AND COMPUTER NETWORKS

Subject Code: **L-T-P: 4:0:0**

Total Hours: 60 **Credits: 4**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Provide knowledge about various types of networking, networks, network topologies
2. Basics of Network Management.
3. Concepts of OSI reference model and real world protocol suite such as TCP/IP
4. Outline the basic network configurations.
5. Explore Security and protection issues.

UNIT 1: **[10 hours]**

Data Communications- Networks, The Internet, Protocols and standards. Network Models - Reference models OSI, Layers in OSI reference model, TCP/IP Protocol suite, Addressing. Data & Signal- Analog and Digital, Transmission impairment, Date Rate Limits, Performance. Digital Transmissions- Digital Conversions, Analog Conversions, Transmission Modes.

UNIT 2: **[13 hours]**

Multiplexing, Transmission Media & Switching- Guided Media – Twisted pair cable, Co-axial cable, Fiber optic Cable, Unguided media – Wireless – Radio waves, Microwaves, Infrared, Circuit switched networks, Datagram networks, virtual circuit networks, Structure of a switch – Structure of Circuit Switches & Packet Switches.

UNIT 3: **[13 hours]**

Error Detection and Correction- Types of Errors, redundancy, Detection VS Correction, Forward error Correction VS Retransmission, Block Coding - Error detection and correction, Hamming Distance, Minimum Hamming Distance, Linear Block Codes, Cyclic Codes –CRC, Checksum.

UNIT 4: **[12 hours]**

Data Link Layer: Data Link Control – Framing, Flow and error control, protocols, Noiseless Channels – Simplest protocol, Noiseless Channels – Stop and wait protocol. Noisy Channel – Stop and wait Automatic Repeat Request, Go- back N Automatic Repeat Request, Selective Repeat, Automatic Repeat Request, piggybacking, HDLC – Configurations and Transfer Modes, Frames, Point to Point Protocols – Framing, Transition phases.

UNIT 5: **[12 hours]**

Multiplexing, multilink PPP. Multiple Access -Random access – ALOHA, CSMA, CSMA/CD,CSMA/CA, Controlled access – reservation, polling, token passing, Channelization – FDMA, TDMA, CDMA. Wired LANs& Connecting Devices - IEEE standards – Data link and Physical Layer, Standard Ethernet – MAC sublayers. Passive Hubs, Repeaters, Active Hub, Bridges, Two-Layer Switches, Routers, Three-Layer Switches, Gateway.

Textbook

1. Behrouz A. *Forouzan, "Data* **Communications and** *Networking",* 5th Edition,McGraw-Hill, 2017. ISBN-10: 1259064751 ,ISBN-13: 978-1259064753

Reference Book

1. William Stallings**,** ***"Data and Computer Communication",*** 8th Edition, Pearson Education, 2013. ISBN-10: 0133506487 ,ISBN-13: 978-0133506488
2. Andrew S.Tanenbaum, ***"Computer Networks",*** 5thEdition, Prentice Hall of India, 2010. ISBN-10: 0132126958, ISBN-13: 978-0132126953
3. Alberto Leon-Garcia and IndraWidjaja**,** ***"Communication Networks-Fundamental Concepts and key architectures"***, Tata Mc-Graw-Hill 2nd Edition, Pearson Education, 2005.
4. L. L. Peterson and B. S. Davie, ***"Computer Networks – A System Approach"***, 5th Edition, Elsevier, 2011.ISBN-10: 0123850592, ISBN-13: 978-0123850591

Course Outcomes:

On completion of this course, students are able to

CO 1 Discuss OSI and TCP/IP models

CO 2 Examine the analog to Digital conversions and vice versa, Multiplexing and various types of transmission media used in data communication

CO 3 Compare different types of switching networks and MAC layer protocols.

CO 4 Employ the different error detection and correction techniques in data link layer

CO 5 Demonstrate the ability to explain networking as it relates to the connection of computers, media, and devices (routing)

CO 6 Design and simulate various topologies using layer 2 and layer 3 devices.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Programme Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1										
CO2	3	3	2									
CO3	3	3	2									
CO4	3	2	1									
CO5	3	2	1									
CO6	3	3	2	2	2							

JAIN DEEMED-TO-BE UNIVERSITY | FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

DATA STRUCTURES LABORATORY

Subject Code: **L-T-P: 0:0:2**

Total Hours : 15 weeks **Credits: 1**

Prerequisite : Problem solving through Programing

Course Learning Objectives (CLO)

Design and Develop programs on derived data types and data structures such as stack, queue, Linked List, Binary search Tree.

#	Name of the Experiment	CO Mapping
1	Design a menu driven Program for the following Array operations: a. Creating an Array of N Integer Elements. b. Inserting an Element at a given valid Position. c. Deleting an Element at a given valid Position. Support the program with functions for each of the operations.	CO1
2	Design a Program to perform the following operations on Two-Dimensional arrays. a. Accept matrix. b. Find the transpose of a matrix. c. To find the norm of a matrix.	CO1
3	Demonstrate the pointer concepts to perform the following: a. To find an element in an array. b. To find the sum of array elements. c. To display memory address and value using pointer to pointer.	CO2
4	Design and Implement following Program to demonstrate the pointer concepts: a. The use of pointer operators and expressions. b. To swap two numbers using functions. c. Different memory allocation functions.	CO2
5	Design, Develop and Implement a menu driven Program for the following operations on Singly Linked List (SLL) for integer data. (*Students will be asked to demonstrate various combinations of insertions and deletions*). a. Creation of N nodes. b. Insertion [beginning, end, position]. c. Deletion [beginning, end, position]. d. Search for key. e. Display [traverse].	CO4
6	Design, Develop and Implement a menu driven Program for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX). a. push(int): Push an Element on to Stack.	CO3

	b. x=pop(): Pop an Element from Stack. c. Demonstrate Empty, Overflow and Underflow situations on Stack. d. Display the status of Stack (Display the top element and position in the stack).	
7	Design, Develop and Implement a Program for the following Stack Applications a. To evaluate a given postfix expression. b. To convert a given infix expression to postfix expression. c. Demonstrate how Stack can be used to check Palindrome.	**CO3**
8	Design, Develop and Implement a Program for the following using Recursive functions. a. To find the factorial of a number. b. To find the GCD of two numbers. c. To find X^N where X is real number and N is an integer number. d. To Solve Towers of Hanoi problem.	**CO5**
9	Design, Develop and Implement a menu driven Program for the following operations on Linear QUEUE of Characters. (Array Implementation of Queue with maximum size MAX). a. Insert an Element on to Linear QUEUE. b. Delete an Element from Linear QUEUE. c. Demonstrate Overflow and Underflow situations on Linear QUEUE. d. Display the status of Linear QUEUE.	**CO3**
10	Design, Develop and Implement a menu driven Program for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX). a. Insert an Element on to Circular QUEUE. b. Delete an Element from Circular QUEUE. c. Demonstrate Overflow and Underflow situations on Circular QUEUE. d. Display the status of Circular QUEUE.	**CO3**
11	Design, Develop and Implement a menu driven Program for the following operations on Doubly Linked List (DLL) for integer data. (Students will be asked to demonstrate various combinations of insertions and deletions). a. Creation of N nodes. b. Insertion [beginning, end, position] c. Deletion [beginning, end, position] d. Search for key e. Display [traverse]	**CO4**
12	Construct Binary Search Tree (BST) of N nodes and perform the following operations: a. Insert new node into the BST. b. Traverse the BST in Inorder, Preorder and Post Order. c. Search the BST for a given KEY element using any one traversal technique and report the appropriate message.	**CO6**

TEXT BOOK

1. "Data Structure using C", Aaron M. Tenenbaum, Yedidyah Langsam & Moshe J. Augenstein, Pearson Education/PHI, 2006.

2. "Data structures and program design in C", 2nd Edition, Robert Kruse.
3. "Data Structures and Algorithm Analysis in C++", Mark Allen Weiss, Third Edition, Pearson Education, 2006

REFERENCE BOOK

1. "Introduction to Data Structures in C", Kamthane:. Pearson Education 2005.
2. "An Introduction to Data Structures with Application ", Trembley and Sorenson, 2nd Edition, MCrawHill, 2004.
3. "Understanding Pointers In C", 4th edition, Yashavant P. Kanetkar
4. "Data structures: A pseducode approach with C", 2nd edition Richard F Gillberg & Behrouz A Frouzan.

OUTCOMES

On completion of the course, students are expected to:

CO 1 Illustrate the concepts of Arrays.

CO 2 Demonstrate the working of pointers and functions.

CO 3 Implement the different operations of Stack and Queue.

CO 4 Demonstrate the concepts of Linked List and apply various operations on them.

CO 5 Choose appropriate recursive techniques to solve given problem.

CO 6 Illustrate the concepts of Binary Search Tree (BST) and its operations.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Program Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	2	1							
CO2	3	2	1	2	1							
CO3	3	2	1	2	1							
CO4	3	2	1	2	2							
CO5	3	2	1	2	2							
CO6	3	2	1	2	2							

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

PROGRAMMING IN JAVA LABORATORY

Subject Code: **L-T-P: 0:0:4**

Total Hours : 15 weeks **Credits: 2**

Prerequisite : Problem solving through Programing

Course Learning Objectives (CLO)

The objective of this course is to make students to

Design and Develop programs on different looping constructs, constructors, inheritance, exception handling, multithreading, event handling, and JDBC connectivity using MySQL/Oracle database.

#	Name of the Experiment	CO Mapping
1.	**Programs on Selection and Iteration Statements**	CO1
	a. Program to print Biggest of 3 Numbers if the numbers are not equal and also print whether the numbers are positive or negative or mixed numbers	
	b. Program to print first 10 numbers in Fibonacci series	
	c. Program to check a neon number (A neon number is a number where the sum of digits of square of the number is equal to the number. For example if the input number is 9, its square is 9*9 = 81 and sum of the digits is 9. i.e. 9 is a neon number)	
	d. Program to find the input number is palindrome or not.	
	e. Program to find the input number is a duck number or not using method (A duck number contains zeros, but there should not be zero present in the beginning of the number. Eg., 3201, 1200)	
2.	**Arrays**	CO1
	a. Program to search an element of the array using for each loop	
	b. Program to sort an Array of elements in Ascending order	
	c. Create a Java class to enter number of students and their total marks. Compute and print the deviation in marks of each student against the average marks of the class.	
	d. Program to demonstrate passing objects as parameters	
3.	**Constructors and Methods**	CO2
	a. Demonstrate different types of constructors	
	b. Create a Java Class “Shape” with constructor to initialize the one parameter “dimension”. Now create three sub classes of Shape with following methods (i) “Circle” with methods to calculate the area and circumference of the circle with dimension as radius. (ii) “Square” with	

	methods to calculate the area and length of diagonal of the square with dimension as length of one side. (assuming length of each side of the square is same). (iii) "Sphere" with methods to calculate the volume and surface area of the sphere with dimension as radius of the sphere. Write appropriate main method to create object of each class and test every method.	
	c. Demonstrate the different operations of Stack	
4.	**Inheritance and Interfaces**	**CO2**
	a. Program to demonstrate multi-level inheritance	
	b. Program to demonstrate multiple inheritance	
	c. Define an interface using JAVA that contains a method to calculate the perimeter of an object. Define two classes-circle and Rectangle with suitable fields and methods. Implement the interface "perimeter" in these classes. Write the appropriate main() method to create object of each class and test all the methods.	
5.	**Exception Handling**	**CO3**
	a. Design programs to demonstrate Exception handling mechanisms	
	b. Design a program to demonstrate user defined exception	
6.	**this, super ,static, final key words**	**CO4**
	a. program to illustrate the keywords i) this ii) super (using inheritance)	
	b. program to illustrate the i) static block ii) static variable iii) static method iv) final keywords	
7.	**Multithreading**	**CO4**
	a. Programs for creating multiple threads a) Using Thread class b) Runnable Interface	
	b. Create two threads in which one displays "Dept of CSE" for every 50 seconds and the other displays " Jain University" for every 100 seconds continuously.	
8.	**Applets and AWT**	**CO5**
	a. Design an Applet display the Sum of Two Numbers and set status message in Applet window	
	b. Draw Smiley in an Applet example.	
	c. Design an applet for Bouncing of a Ball	
9.	**Event Handling in JAVA**	**CO5**
	a. Create a Frame with a button having caption PRESS ME, once the button is clicked, the caption changes to PRESSED.	
	b. Create an Applet with three text fields and a button. Input integer values in first two Text Fields. On Click of add button, the sum should be displayed in the third Text Field	
	c. Create a swing applet that has two buttons named alpha and beta. When either of the buttons pressed, it should display "Alpha is pressed" or : Beta is pressed"	
10.	**JDBC Connectivity**	**CO6**
	a. Demonstrate the use the JDBC connectivity using MySQL/Oracle	

TEXTBOOKS:

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011
2. Jim Keogh :J2EE - The Complete Reference –Tata McGraw Hill, 2007.

OUTCOMES

On completion of the course, students are expected to:

CO 1 Use java programming constructs to explore different looping constructs and to work with arrays.

CO 2 Demonstrate the different types of constructors and inheritance

CO 3 Examine why java is a robust language using Exception handling mechanism.

CO 4 Demonstrate the advantages of multithreading concepts through programming.

CO 5 Demonstrate the delegation model of event handling mechanism using Applets and Frames.

CO 6 Demonstrate the use the JDBC connectivity using MySQL/Oracle database.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Program Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2		1							
CO2	3	2	2		2							
CO3	3	3	2	2	3							
CO4	3	2	2	2	3							
CO5	3	2	2	2	3							
CO6	3	2	2	2	3							

OPERATING SYSTEM

Subject Code: **L-T-P: 3:0:0**

Total Hours: 45 Hours **Credits: 3**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Understand and identify the main components of an operating systems and their functions.
2. Study the process management and learn the various scheduling mechanisms.
3. Understand the concept and implementation of memory management policies.
4. Conceptualize the working of an operating system as a resource manager, file system manager, process manager, memory manager and input output manager and to learn methods used to implement the different parts of OS
5. Analyses and learn various file system designs, their implementations and security policies, measures.

UNIT I- Introduction to Operating System **[06 Hours]**

Introduction, Objectives and Functions of OS, Evolution of OS, OS Structures, OS Components, OS Services, System calls, System programs, Virtual Machines.

UNIT II- Process Management **[11 Hours]**

Processes: Process concept, Process scheduling, Co-operating processes, Operations on processes, Inter process communication, Communication in client-server systems.

Threads: Introduction to Threads, Single and Multi-threaded processes and its benefits, User and Kernel threads, Multithreading models, threading issues.

CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling Algorithms, Multiple Processor Scheduling, Real-time Scheduling, Algorithm Evaluation, Process Scheduling Models.

Process Synchronization: Mutual Exclusion, Critical – section problem, Synchronization hardware, Semaphores, Classic problems of synchronization, Critical Regions, Monitors, OS Synchronization, Atomic Transactions

Deadlocks: System Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

UNIT III- Storage Management: **[10 Hours]**

Memory Management: Logical and physical Address Space, Swapping, Contiguous Memory Allocation, Paging, Segmentation with Paging.

Virtual Management: Demand paging, Process creation, Page Replacement Algorithms, Allocation of Frames, Thrashing, Operating System Examples, Page size and other considerations, Demand segmentation

Disk Management: Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, Disk Attachment, stable-storage Implementation

UNIT IV- File Management: [10 Hours]

File-System Interface: File concept, Access Methods, Directory structure, File- system Mounting, File sharing, Protection and consistency semantics

File-System Implementation: File-System structure, File-System Implementations, Directory Implementation, Allocation Methods, Free-space Management, Efficiency and Performance, Recovery

UNIT V- Protection and Security: [08 Hours]

Protection: Goals of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Revocation of Access Rights, Capability- Based Systems, Language – Based Protection

Security: Security Problem, User Authentication, One – Time Password, Program Threats, System Threats, Cryptography, Computer – Security Classifications.

TEXTBOOKS:

1. Abraham Silberschatz and peter Baer Galvin, Operating System Concepts, 8th Edition, Pearson Education.

REFERENCE BOOKS:

1. Milan Milonkovic, Operating System Concepts and design, II Edition, McGraw Hill 1992.
2. Tanenbaum, Operation System Concepts, 2nd Edition, Pearson Education.
3. Silberschatz / Galvin / Gagne, Operating System,6thEdition,WSE (WILEY Publication)
4. William Stallings, Operating System, 4th Edition, Pearson Education.
5. H.M.Deitel, Operating systems, 2nd Edition, Pearson Education

Course Outcomes:

On successful completion of this course, student should be able to:

- **CO 1** Describe the important computer system resources and the role of operating system in their management policies and algorithms.
- **CO 2** Discuss the process, management policies and scheduling of the processes by the CPU.
- **CO 3** Test the requirement for process synchronization and coordination handled by OS.
- **CO 4** Describe and analyse the memory management schemes and allocation methods.
- **CO 5** Classify different file systems and their implementations.
- **CO 6** Compare the security and protection mechanisms related to an OS.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	2	1										
CO3	3	3	2									
CO4	2	1										
CO5	2	1										
CO6	3	2	2									

JGI JAIN DEEMED-TO-BE UNIVERSITY | FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

MATHEMATICS & STATISTICS FOR MACHINE LEARNING

Subject Code: **L-T-P: 4:0:0**

Total Hours: 60 **Credits: 4**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Enable an understanding of statistics with business examples, and compare the different statistical ways of describing data.
2. Examine the statistical capabilities.
3. Explore the measures of central tendency, variation and position for defining data.
4. Interpret the laws of probability and explain how Bayes theorem applies to data analysis.
5. Define sampling and and identify sampling errors.
6. Explain hypothesis testing and apply principles of hypothesis testing for small and large samples.

UNIT 1: Introduction to Statistics **[09 hours]**

Applications of Statistics in Business - Presenting Data – Different Types of Data - Primary Data and Secondary Data - The Numeric Data - Continuous Frequency Distribution - Class Interval - Categorical data - Statistical Software for Analysis – Exploring Statistical capabilities of popular tools.

UNIT 2: Descriptive Statistical Analytics **[11 hours]**

Calculating Measures of Central Tendency – Mean, Median and Mode - Calculating Measures of Dispersion - variance measures - Standard Deviation: The Coefficient of variation measures - Graphing data - Graphical measures - Measure of Skewness, Symmetrical distribution - Kurtosis - Descriptive Statistics with a demonstration and Case study.

UNIT 3: Probability Theory & Distributions **[12 hours]**

Probability Theory and Distributions - Fundamental Concepts of Probability - Definitions Probability - Applying Laws of Probability - Bayes theorem - Calculating Random variable and Probability -Distribution with a Case Study - Probability Distribution.

UNIT 4: Sampling and Confidence intervals **[12 hours]**

Introduction to Sampling - Sampling Theory - Sampling Distribution - Using probabilistic Sampling Techniques - Estimating Sampling Errors and Confidence Intervals - Sampling Error and Non-Sampling Error - Central Limit Theorem - Case Study on Sampling Techniques.

UNIT 5: Hypothesis testing **[16 hours]**

Introduction to Null Hypothesis - Alternate Hypothesis - Testing Hypothesis for Large Samples - Test for Single Proportion - Test for Difference of Proportions - Testing Hypothesis for Small Samples - T-test - Applications of T-test - P-test - Calculating Analysis of Variance - Two-Way Factorial ANOVA - Multivariate Analysis of Variance - Performing Chi-Square Test - Applications of the C2 Test - Testing the Goodness of Fit - Case Study on Hypothesis Testing.

TEXTBOOKS:

1. Statistics for Big Data for Dummies; Alan Anderson, David Semmelroth; ISBN 9788126558223
2. Applied Business Statistics, 7ed, ISV (Author- Ken Black)
3. Machine Learning (in Python and R) For Dummies by John Paul Mueller and Luca Massaron – Wiley

REFERENCES:

1. Data mining and Business Intelligence (Includes Practicals); S.K. Shinde, Uddagiri Chandrasekhar; 789351197188
2. Python Machine Learning, Second Edition by Sebastian Raschka Vahid Mirjalili- PACKT publications
3. Machine Learning by Saikat Dutt, Subramanian Chandramouli, et al.- Pearson
4. Statistical Analysis with Excel For Dummies, 4th Edition; Joseph Schmuller; ISBN: 978-1-119-27116-1

Course Outcomes:

On completion of this course, students are able to

- **CO 1** Compare applications of Statistics in Business, different types of Data, Continuous Frequency Distribution, Categorical data and Statistical Software for Analysis.
- **CO 2** Report the Measures of Central Tendency, Dispersion, variance and Standard Deviation.
- **CO 3** Examine the distribution of data by Class or Category using frequency distribution for quantitative data and qualitative values and cumulative frequency distributions.
- **CO 4** Discuss the fundamental, definitions and laws of Probability and Bayes theorem.
- **CO 5** Summarise the concepts of Sampling Theory, Sampling Distribution, Sampling Techniques, Estimating Sampling Errors and Confidence Intervals.
- **CO 6** Test Hypothesis for Large Samples, Single Proportion, Difference of Proportions and Hypothesis for Small Samples.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Programme Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1		2							
CO2	2	1			1							
CO3	3	2	2		2							
CO4	2	1			1							
CO5	2	1			2							
CO6	3	2	2		2							

JGI JAIN DEEMED-TO-BE UNIVERSITY | FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

DATABASE MANAGEMENT SYSTEM

Subject Code: **L-T-P: 3:0:0**

Total Hours: 45 **Credits: 3**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Have a broad understanding of database concepts and database management system software
2. Be able to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.
3. Have a high-level understanding of major DBMS components and their functions
4. Be able to write SQL commands to create tables and indexes, insert/update/delete data, and query data in a relational DBMS.
5. Be able to program a data-intensive application using DBMS APIs.

UNIT 1: **[09 hours]**

Introduction to Databases : Characteristics of database approach, Advantages of using the DBMS approach, Actors on the scene and workers behind the scene, History of database applications. **Database systems Concepts and Architecture:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database. languages, and interfaces, The Database System environment. **Conceptual Data Modeling using Entities and Relationships:** Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, examples

UNIT 2: **[09 hours]**

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping.

UNIT 3: **[08 hours]**

SQL: SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL. **SQL : Advances Queries:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.

UNIT 4: **[09 hours]**

Internet Applications: The three-Tier application architecture, The presentation layer, The Middle Tier. **Database Application Development:** Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures. **NOSQL Databases:** Introduction to NOSQL Systems , The CAP Theorem Document-Based NOSQL Systems NOSQL Key-Value Stores , Column-Based or Wide Column NOSQL Systems , NOSQL Graph Databases

UNIT 5: **[10 hours]**

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. **Transaction Processing:** Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

TEXTBOOKS:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

REFERENCES:

1. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, Mc-GrawHill, 2013.
2. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

Course Outcomes:

On completion of this course, students are able to

- **CO 1** Use the appropriate symbols for the construction of Entity-Relationship (ER) model
- **CO 2** Demonstrate by providing solutions through Relational Algebraic expressions.
- **CO 3** Test simple and complex SQL queries for retrieving of tuples.
- **CO 4** Test the execution of NOSQL queries.
- **CO 5** Differentiate the different normalization techniques by understanding the essential DBMS concepts.
- **CO 6** Demonstrate the ACID properties of Transaction and concurrency control in databases.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Programme Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1									
CO2	3	2	1									
CO3	3	3	2	2	2							
CO4	3	3	2		2							
CO5	3	3	2									
CO6	3	3	2									

JGI JAIN DEEMED-TO-BE UNIVERSITY | FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

INTRODUCTION TO ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Subject Code: **L-T-P: 4:0:0**

Total Hours: 60 **Credits: 4**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Understand the components of Machine Learning
2. Build predictive models using Supervised Machine Learning
3. Segment data using Unsupervised Machine Learning
4. Understand the importance of the wisdom of crowds and Ensemble Learning.
5. Build Deep Neural Networks for Artificial Intelligence
6. Apply Natural Language Processing techniques to text data.

UNIT 1: Supervised Machine Learning **[16 hours]**

Exploratory Data Analysis, Overview of Regression, Linear Regression with OLS technique, Classification using Logistic Regression, Philosophy of Decision Trees, Model Validation Measures, Dimension Reduction using L1, L2 Regularization, Use of Gradient Descent techniques.

UNIT 2: Unsupervised Machine Learning **[08 hours]**

Introduction to Segmentation using clustering, Agglomerative Hierarchical clustering, Clustering by similarity aggregation, K- Means clustering, Applications of clustering.

UNIT 3: Ensemble Learning **[12 hours]**

Over-fitting and Under-fitting of Models, Ensemble learning and Models, Bagging and Random Forests, AdaBoost Boosting algorithm, Gradient boosting machines and interpretation.

UNIT 4: Introduction to Deep Learning **[12 hours]**

Introduction to neural network, Decision boundary, Non- linear decision boundary, Neural network algorithm, Introduction to CNN, create, train and test dataset for convoluted features, CNN architecture, Introduction to RNN, Architecture of RNN; RNN models.

UNIT 5: Natural Language Processing **[12 hours]**

Introduction to NLP, Text mining basics, preparing data for text mining, getting started with NLTK packages, Interpreting Tokens, working with stemming and Lemmatizing tokens, Creating document term matrix, Documentation Categorization, Classifying text using SVM, Social Media Analytics metrics and measurement, Elements of social media analytics, Sentiment Analysis using Naïve Bayes Algorithm.

TEXTBOOKS:

1. Machine Learning using Python by U Dinesh Kumar Manaranjan Pradhan; Wiley
2. Machine Learning (in Python and R) For Dummies by John Paul Mueller and Luca Massaron – Wiley

REFERENCES:

1. Python Machine Learning, Second Edition by Sebastian Raschka Vahid Mirjalili- PACKT publications
2. Machine Learning by Saikat Dutt, Subramanian Chandramouli, et al.- Pearson

Course Outcomes:

On completion of this course, students are able to

CO 1 Differentiate between Supervised and Unsupervised machine learning techniques.

CO 2 Use supervised machine learning techniques for Regression and Classification.

CO 3 Solve business problems using supervised machine learning techniques Regression and Classification

CO 4 Use cluster analysis to segment and classify data.

CO 5 Solve business problem using advanced machine learning techniques such as Deep Learning and Neural Networks.

CO 6 Select text data for analysis and perform sentiment analysis of tweets using Naïve Bayes.

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Programme Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2		2							
CO2	3	2			2							
CO3	3	2			1							
CO4	3	2			2							
CO5	3	2			2							
CO6	3	3	2		2							

JGI JAIN DEEMED-TO-BE UNIVERSITY | FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

PYTHON PROGRAMMING

Subject Code: **L-T-P: 0:2:2**

Total Hours: 45 **Credits: 3**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Master the basic programming constructs (branches, loops, functions).
2. Work with control structure such as branches, loops and functions.
3. Understand the how string and classes support the sequence methods in Python.
4. Explore advanced topics such as inheritance, exceptions.
5. Understand the advance algorithms of search and sort in Python.

UNIT 1: Python Basics **[08 hours]**

Programming using Python, Basic input and output, Errors, Development environment, Language history, Variables and assignments, Identifiers, Objects, Numeric types: Floating-point, Arithmetic expressions, Python expressions, Division and modulo", Module basics, Math module, representing text, String basics, List and Set basics, Common data types summary, Type conversions, Binary numbers, String formatting

UNIT 2: Branch, Loops and Functions **[09 hours]**

If-else branches (general), If-else statement, more if-else, Equality and relational operators, Boolean operators and expressions, Order of evaluation", Membership and identity operators, Code blocks and indentation, Conditional expressions Loops, while loops, Counting, For loops

Counting using the range () function, while vs. for loops, Nested loops, Break and continue, Loop else, User-defined function basics, returning values from functions, Reasons for defining functions, Function stubs, Functions: Common errors, Function arguments

UNIT 3: Strings, Classes and Exceptions **[09 hours]**

String slicing, Advanced string formatting, String methods, Splitting and joining strings, the string format method, Classes: Grouping data, Class methods, Class and instance object types, Class constructors, Class interfaces, Class customization, Classes as numeric types, Memory allocation and garbage collection, Handling exceptions using try and except, Multiple exception handlers, raising exceptions, Exceptions with functions, using finally to clean up, Custom exception types.

UNIT 4: Modules, Files and Inheritance [09 hours]

Modules, finding modules, importing specific names from a module, executing modules as scripts, Reloading modules, Packages and Standard library, reading files, Writing files

Interacting with file systems, Binary data, Command-line arguments and files, the 'with' statement, Comma separated values files, Derived classes, accessing base class attributes, overriding class methods, Is-a versus has-a relationships, Mixing classes and multiple inheritance

UNIT 5: Recursion, Plotting, Searching Sorting Algorithms [10 hours]

Recursive functions, Recursive algorithm: Search, adding output statements for debugging, creating a recursive function, Recursive math functions, Recursive exploration of all possibilities, Introduction to plotting and visualizing data, Styling plots, Text and annotations, NumPy, Multiple plots, Searching and algorithms, Binary search, O notation, Algorithm analysis, Sorting: Introduction, Selection sort, Insertion sort, Quicksort, Merge sort

TEXTBOOKS:

1. Programming in Python- Zybook- Wiley Product

REFERENCES:

1. Fluent Python – by Luciano Ramalh, O'Reilly Publications
2. Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming
3. Beginning Programming with Python for Dummies, 2ed by John Paul Mueller

Course Outcomes:

On completion of this course, students are able to

CO 1 Discuss both the principles and the practice of programming, using Python.

CO 2 Use iteratively function and loops in Python for managing and transforming data.

CO 3 Demonstrate the working of basic String operations

CO 4 Demonstrate the programming skill using class operations.

CO 5 Implement the writing and reading files in Python.

CO 6 Demonstrate the visualisation of data using Python plots and perform search and sort functions.

CO/PO: Mapping (3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			1							
CO2	3	2	1		1							
CO3	3	2	1		2							
CO4	3	2	1		2							
CO5	3	2	1		2							
CO6	3	2	1		2							

JGI JAIN DEEMED-TO-BE UNIVERSITY | FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

OPERATING SYSTEMS LABORATORY

Subject Code: **L-T-P: 0:0:2**

Total Hours: 15 weeks **Credits: 1**

Course Learning Objectives (CLO)

The objective of this course is to make students to

1. Make students understand the basic design of operating systems.
2. Improve their programming skills to implement the concepts in operating system.
3. Use the simulator to experience the working methodology of CPU scheduling and so on.
4. Have practical view of functional services of operating system

#	Name of the Experiment	CO Mapping
1	Scheduling Algorithms a) FCFS (with and without arrival times) b) SJF (with and without arrival times) c) SRT (SJF with pre-emption based on shortest remaining time) d) Priority (with and without arrival times) e) Round Robin (with and without arrival times)	**CO1**
2	Mutual Exclusion Problem with Dekker's Algorithm (Give 'n' processes solution using Bakery Algorithm)	**CO2**
3	Classical Synchronization Problems (Implement using Semaphores) a) Producer / Consumer b) Readers / Writers c) Dining Philosophers	**CO2**
4	Deadlock Avoidance algorithm (Banker's Algorithm)	**CO4**
5	Memory Management a) First-Fit (include fragments) b) Best-Fit (include fragments) c) Worst-Fit (include fragments)	**CO3**
6	Replacement Algorithms a) FIFO b) LRU c) Optimal	**CO5**
7	Shared memory segment	**CO5**
8	File locking Implementation	**CO6**

TEXTBOOKS:

1. Abraham Silberschatz and peter Baer Galvin, Operating System Concepts, 8th Edition, Pearson Education.

REFERENCE BOOKS:

1. Milan Milonkovic, Operating System Concepts and design, II Edition, McGraw Hill 1992.
2. Tanenbaum, Operation System Concepts, 2nd Edition, Pearson Education.
3. Silberschatz / Galvin / Gagne, Operating System,6thEdition,WSE (WILEY Publication)
4. William Stallings, Operating System, 4th Edition, Pearson Education.
5. H.M.Deitel, Operating systems, 2nd Edition, Pearson Education

Course Outcomes:

On completion of this course, students are able to

CO 1 Demonstrate practical knowledge on principles of operating systems.

CO 2 Employ the process synchronous concept using message queue, shared memory, semaphore and Dekker's algorithm for the given situation.

CO 3 Demonstrate the working of CPU Scheduling Algorithms. (FCFS, RR, SJF, Priority, Multilevel Queuing)

CO 4 Demonstrate the Banker's Algorithm for Deadlock Avoidance and Prevention.

CO 5 Employ the various methods in memory allocation and page replacement algorithm.

CO 6 Demonstrate the various operations of file system

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
Course Outcome (COs)	**Programme Outcome (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1		1							
CO2	3	2	1		2							
CO3	3	2	1		2							
CO4	3	2	1		2							
CO5	3	2	1		2							
CO6	3	2	1		2							

JGI JAIN DEEMED-TO-BE UNIVERSITY | FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Specialization with Artificial Intelligence and Machine Learning)

DATABASE MANAGEMENT SYSTEM LABORATORY

Subject Code: **L-T-P: 0:0:2**

Total Hours : 15 weeks **Credits: 1**

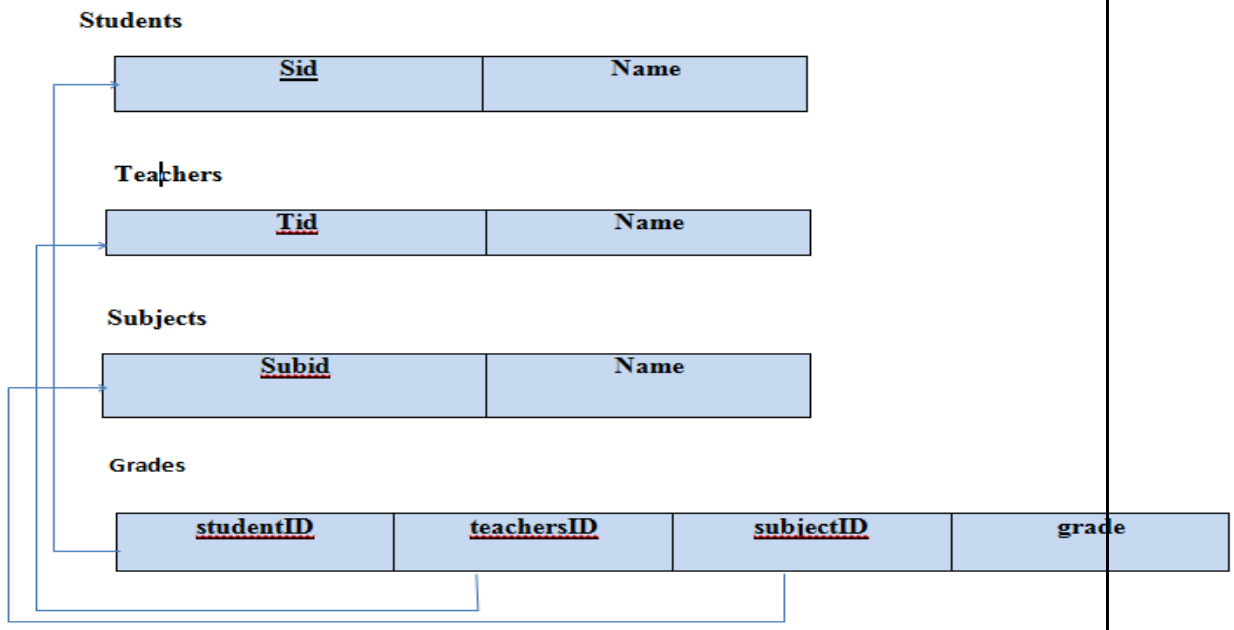
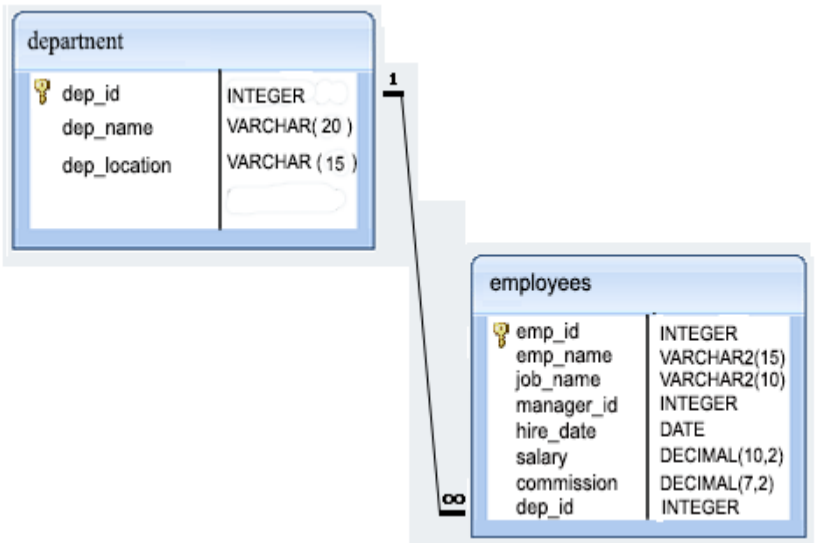
Prerequisite : Problem solving through Programing

Course Learning Objectives (CLO)

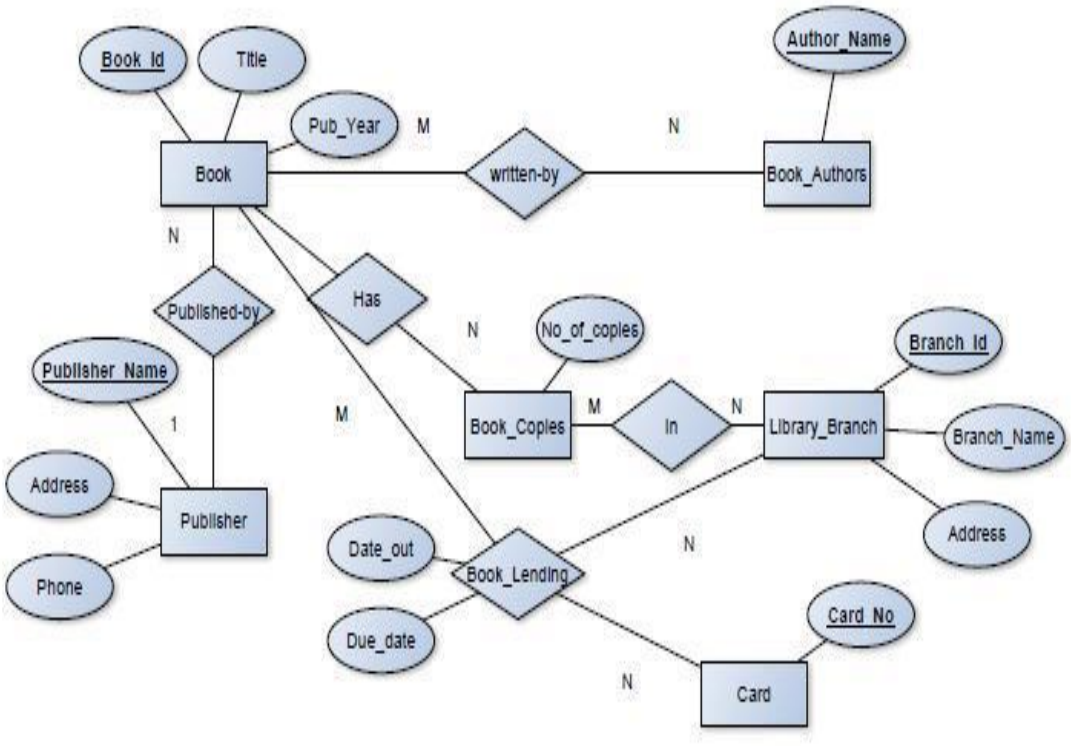
The objective of this course is to make students to

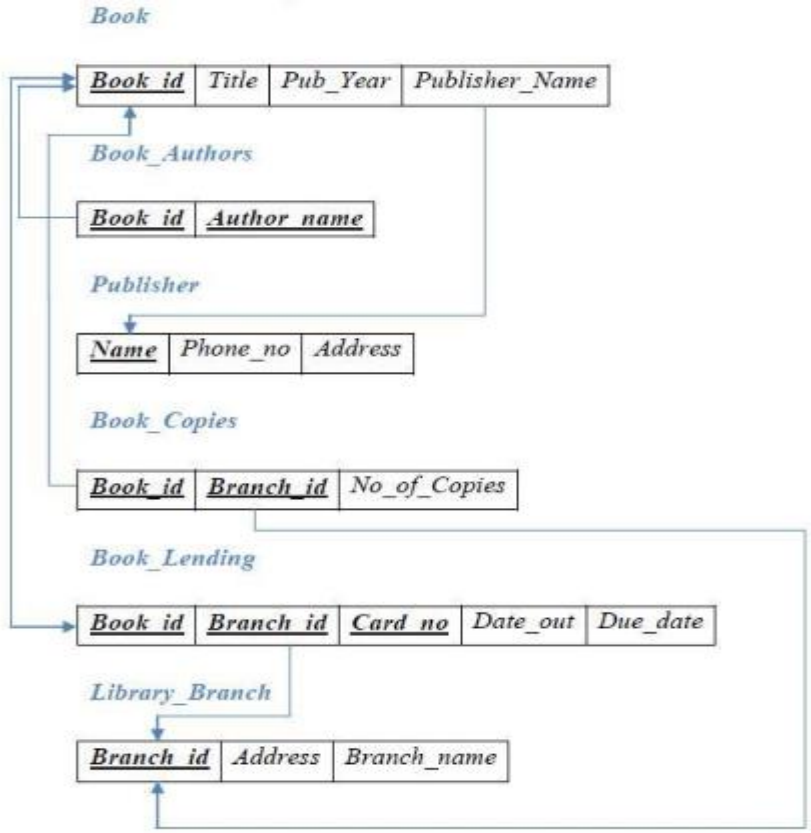
1. Understand the role of a database management systems in an organization.
2. Understand basic database concepts, including the structure and operation of the relational data model.
3. Construct simple and moderately advanced database queries using Structured Query Language (SQL).
4. Understand and successfully apply logical database design principles, including E- R diagrams and database normalization.
5. Design and implement a small database project using Oracle database software.
6. Understand the concept of a database transaction and related database facilities, including concurrency control, journaling, backup and recovery, and data object locking and protocols.
7. Understand the role of the database administrator.

Sl No	Program Title	CO Mapping
	PART A	
1.	Execute different Data Definition Language (DDL), Data Manipulation Language (DML), DCL, TCL commands on a sample database. DDL: CREATE, DROP, TRUNCATE,ALTER AND RENAME DML: INSERT, UPDATE AND DELETE	**CO1**
2.	Consider the Student Database consisting of four relations Students, Teachers , subjects and Grades. Create all the tables with necessary constraints. Students(**Sid int**, Name string) Teachers(**Tidint**, Name string) Subjects(**Subidint**, Name string) Grades(**studentID**int, **teachersID**int, **subjectID**int, grade string)	**CO2**

	SCHEMA DIAGRAM  	
3.	Insert at least five tuples to all the relations of the Student database	**CO3**
4.	a. List the students as per their alphabetic order b. List the names of students in any class taught by Adams c. Names of teachers who taught Biology d. Retrieve the names of teachers who have not yet taught e. List the names of students who have not yet taken any classes f. List the names of students who have not yet taken any classes:	**CO3**
5.	Consider the Employee Database consisting of two relations Employees and department. Create all the tables with necessary constraints. **Database Scheme**  	
6.	Insert at least five tuples to all the relations of the Employee database	**CO4**
7.	a. Write a query in SQL to display the unique designations for the employees b. Write a query in SQL to produce the output of employees name and job name as a format of "Employee & Job"	**CO4**

	c. Write a query in SQL to list the employees with Hire date in the format like February 22, 1991 d. Write a query in SQL to count the no. of characters with out considering the spaces for each name. e. Write a query in SQL to list the employees who does not belong to department 102	
8.	a. Write a query in SQL to display the average salaries of all the employees who works as HR. b. Write a query in SQL to list the employees whose salary will be more than 10000 after giving 25% increment. c. Write a query in SQL to list the employees who have joined in the year 2020. d. Write a query in SQL to list the employees along with department name. e. Write a query in SQL to list the employees, joined in the month FEBRUARY with a salary range between 1001 to 20000. **f.** Write a query in SQL to list the name, job name, manager id, salary, manager name, manager's salary for those employees whose salary is greater than the salary of their managers	**CO4**
9.	a. Write a query in SQL to list the employees whose manager name is Vamshi . b. Write a query in SQL to list the employees who are working either MANAGER or HR with a salary range between 20000 to 100000 without any commission. c. Write a query in SQL to list the employees who are senior to their own manager. d. Write a query in SQL to display the location of ISHIKA. e. Write a query in SQL to list the total information of employees table along with department, and location of all the employees working under marketing and HR in in the ascending department no. **f.** Write a query in SQL to list the details of the employees along with the details of their departments.	**CO4**
10.	a. Write a query in SQL to find the average salary and average total remuneration(salary and commission) for each type of job. b. Write a query in SQL to list the manager no and the number of employees working for those managers in ascending order on manager id. c. Write a query in SQL to list the department where at least two employees are working. d. Write a query in SQL to display the number of employee for each job in each department.	**CO4**

	e. Write a query in SQL to find the total annual salary distributed against each job in the year 1995. **f.** Write a query in SQL to list the employee id, name, salary, and department id of the employees in ascending order of salary who works in the department 1001	
11.	Consider the LibraryDatabase consisting of six relations Publisher, Book, Book_Authors, Book_Copies, Book_lending and Library_Branch. Create all the tables with necessary constraints and insert at least five tuples to each relation. PUBLISHER (Name, Address, Phone) BOOK (Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS (Book_id, Author_Name) BOOK_COPIES (Book_id, Branch_id, No-of_Copies) BOOK_LENDING (Book_id, Branch_id, Card_No, Date_Out, Due_Date) LIBRARY_BRANCH (Branch_id, Branch_Name, Address) **ER Diagram** 	**CO5**

	Schema Diagram 	
12.	NoSQL and Query Evaluation a. Run Formatter classes to display the NoSQL data b. Duplicate elimination c. Join Algorithms	**CO5**
	PART B Mini project on database application using any programming language for front end design and Oracle as back end.	**CO6**

TEXTBOOKS:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

REFERENCES:

1. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, Mc-GrawHill, 2013.
2. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

OUTCOMES

On completion of the course, students are expected to:

CO 1 Implement Data Definition Language, Data Manipulation Language, Data Control Language and Transaction Control Language commands on sample database.

CO 2 Choose a Student database with necessary constraints and get it populated with the data.

CO 3 Examine the execution of simple and complex queries on Student Database.

CO 4 Examine the execution of simple and complex queries on Student Database.

CO 5 Demonstrate the execution of NoSQL queries

CO 6 Develop a mini project for the benefits of society /community

CO/PO: Mapping												
(3/2/1 indicates strength of correlation) 3-High, 2-Medium, 1-Low												
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CO3	3	3	2		3							
CO4	3	3	2		3							
CO5	3	2			3							
CO6				3	3	2	2	2	2	2	2	2