K. K. Wagh Institute of Engineering Education and Research, Nasik (Autonomous w.e.f. A.Y.2022-23)
Details of Course Structure: S.Y.B.Tech Artificial Intelligence and Data Science

● **Summary of Credits and Total Marks for U.G. Programme:**

Semester	S.Y.B.Tech	
	Total Credits (TH+PR/OR/TU)	**Total Marks**
III	21	725
IV	21	725
Total	**42**	**1450**

● **Description of various Courses:**

Type of Course	Description	Type of Course	Description
ESC	Engineering Science Course -Workshop - Drawing-Fundamentals of different branches	DCC	Department Core Course
BSC	Basic Science Courses	DEC	Department Elective Course
LHSM	Liberal arts, Humanities, Social Sciences and Management courses	OEC	Open Elective Courses of other technical or emerging areas /Courses designed by Industry
PSI	Project work, Seminar, Internship, PBL	IMC	Induction and Mandatory Courses
NC/AC	Non Credit Courses	ASM	Additional Specialized/MOOCs

K. K. Wagh Institute of Engineering Education and Research, Nasik (Autonomous w.e.f. A.Y.2022-23)
Details of Course Structure: S.Y.B.Tech Artificial Intelligence and Data Science

Course Code	Course Type	Title of Course	Teaching Scheme Hrs./week			Evaluation Scheme and Marks								Credits			
			TH	TU	PR	InSem	EndSem	CCE	TU	TW	PR	OR	Total	TH	TU	PR*	Total
COM222001	DCC	Fundamentals of DataStructures	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ADS222002	DCC	Computer Networks	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222003	DCC	Discrete Mathematics	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222004	ESC	Digital Electronics and Logic Design	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222005	DCC	Programming Paradigms and Java Programming	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ADS222006	LHSM	Emotional Intelligence	1	-	-	-	-	-	-	25	-	-	25	1#	-	-	1
COM222007	DCC	Data Structures Lab	-	-	4	-	-	-	-	25	50	-	75	-	-	2	2
COM222008	ESC	Digital Electronics Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
ADS222009	DCC	Programming Paradigms and Computer Networks Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
COM222010	PSI	Python Programming Lab	-	-	2	-	-	-	-	25	-	-	25	-	-	1	1
		Total	**16**	**-**	**10**	**100**	**300**	**100**	**-**	**125**	**100**	**-**	**725**	**16**	**-**	**5**	**21**

Note: Credits are as per the Teaching Scheme
* Credits for PR are linked with PR/ OR/ TW/ TU
# This Credit will be assessed as TW

Course Code	Course Type	Title of Course	Teaching Scheme Hrs./week			Assessment Scheme of Marks								Credits			
			TH	TU	PR	InSem	EndSem	CCE	TU	TW	PR	OR	Total	TH	TU	PR*	Total
SMH222111	BSC	Applied Mathematics–III	3	1	-	20	60	20	25	-	-	-	125	3	1	-	4
COM222012	DCC	Advanced Data Structures	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222013	DCC	Operating Systems	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ADS222014	DCC	Database Management Systems	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222015	LHSM	Software Engineering and Project Management	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ADS222016	ASM	Design Thinking	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COM222017	DCC	Advanced Data Structures Lab	-	-	4	-	-	-	-	25	50	-	75	-	-	2	2
COM222018	DCC	Operating Systems Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
ADS222019	DCC	Database Management Systems Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
ADS222020	PSI	Project Based Learning-Design Thinking	-	-	2	-	-	-	-	25	-	-	25	-	-	1	1
Total			**16**	**1**	**10**	**100**	**300**	**100**	**25**	**100**	**100**	**-**	**725**	**15**	**1**	**5**	**21**

Note: Credits are as per the Teaching Scheme
* Credits for PR are linked with PR/ OR/ TW/ TU

S. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: III
ADS222001: Fundamentals of Data Structures

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses:- FYE221010: Programming in C, FYE221011:Programming in CPP

Companion Course:- ADS222007: Data Structures Laboratory

Course Objectives:
- To understand basic concepts and terminology of algorithms and data structures
- To study data structures arrays, linked lists, stack and queues
- To learn searching and sorting methods

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Describe the fundamental concepts and terminology of data structures and algorithms, including arrays, linked lists, stacks, queues and searching and sorting algorithms	2-Understand
CO2	Demonstrate the ability to choose and implement appropriate data structures such as Array, linked list, stack and queue to solve a given problem	3-Apply
CO3	Implement algorithms for array and linked list processing such as insertion, and deletion using C++	3-Apply
CO4	Use stack and / or queue to solve the given problem	3-Apply
CO5	Compare different searching and sorting algorithms based on their performance, strengths, and limitations.	3-Apply

COURSE CONTENTS

Unit I	Introduction to Algorithms and Data Structures	(06 hrs)	COs Mapped - CO1

Algorithms-Introduction, Characteristics, Analysis of algorithms
Complexity of algorithms- Space complexity, Time complexity, Big O notation
Data, Data objects, Data types, Data structure**,** Abstract Data Types (ADT), Primitive and non-primitive, linear and nonlinear, static and dynamic, persistent and ephemeral data structures

Unit II	Sequential Organization	(08 hrs)	COs Mapped - CO1,CO2, CO3

Sequential Organization- Concept, Array as an abstract data type, Memory representation and address calculation, Inserting and deleting an element, Multidimensional arrays, Ordered lists
Single Variable Polynomial-Representation, evaluation and addition
Sparse Matrix-Sparse matrix representation, addition, simple transpose, fast transpose
String- Operations using arrays. Pattern matching algorithm- Naive pattern matching, Rabin Karp algorithm

Unit III	Linked Organization	(08 hrs)	COs Mapped - CO1, CO2, CO3

Linked lists-Concept, Linked list as an Abstract data type, Comparison of sequential and linked organizations

Realization of Linked list- using arrays, using dynamic memory management, header node, advantages and disadvantages of linked list

Linked list operations-Insert a node, delete a node, traverse, copy, reverse, concatenate, delete list

Types of linked list-Linear, circular , Doubly linked list and operations, Representation of a Polynomial using linked list

Generalized Linked List (GLL)-Concept, Representation of polynomial and sets.

Unit IV	Stacks and Queues	(08 hrs)	COs Mapped - CO1, CO2, CO4

Stacks-Concept, Stack as an ADT, Representation of stacks using array and linked list, stack operations, Multi-stacks

Applications of Stack- Polish notation, expression conversion and evaluation, Processing of function calls and Returns

Recursion- Concept, Types of recursion-Direct recursion, Indirect recursion, Tail recursion, Linear recursion, Tree recursion, Comparison of recursion and iterations, Backtracking algorithmic strategy, use of stack in backtracking

Queues- Concept, Queue as ADT, Realization of queues using arrays and linked list, Circular queue, Deque, Multi-queues, Linked queue and operations.

Applications of Queue: Scheduling, Josephus problem

Self Study- Four Queens problem.

Unit V	Searching and Sorting	(06 hrs)	COs Mapped - CO1, CO5

Searching Techniques- Sequential search, Binary search, Fibonacci search.

Sorting- Internal and external sorting, Sort order, Stability, Efficiency, Number of passes

Sorting methods- Bubble sort, Insertion sort, Selection sort, Quick sort, Shell sort, Bucket sort, Radix sort, Merge sort ,Comparison of Sorting Methods.

Self Study- Jump search.

Text Books
1. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786
2. J. Tremblay, P. Soresan, "An Introduction to data Structures with applications", TMH Publication, 2nd Edition, 1984. ISBN:0-07-462471-7
Reference Books
1. Sartaj Sahani, "Data Structures, Algorithms and Applications in C++", Second Edition, University Press, ISBN:9788173715228
2. G A V Pai, "Data Structures and Algorithms", McGraw-Hill Companies, ISBN:9780070667266

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Quiz on Unit-1, Unit-2, Unit-3 (Quiz 10 marks on each unit and will be converted to 10 Marks)	10
2	Theory assignment on Unit- 4 and 5 (10 marks assignment on unit 4 and 5 each and that will be converted in to 10 Marks)	10
	Total	**20**

S. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: III
ADS222002 : Computer Networks

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs./week	03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks

Prerequisite Courses: - ADS222004 Computer Architecture

Companion Course :- ADS222009 Programming Paradigms and Computer Networks Laboratory

Course Objectives:
- To understand fundamental concepts of networking standards, protocols, hardware and technologies
- To Understand the basics of error detection including parity, checksums, and CRC
- To Understand the client/server model and key application layer protocols
- To Learn sockets programming and how to implement client/server applications
- To Understand the concepts of reliable data transfer, principles of routing, semantics and syntax of IP

Course Outcomes: On completion of the course, students will be able to

	Course Outcomes	Bloom's Level
CO1	Summarize fundamental concepts of computer network, architectures, models, technologies and security aspects	2 - Understand
CO2	Illustrate functions of HTTP, DNS and SMTP protocols.	2-Understand
CO3	Explain the Transport Layer functions such as port addressing, socket programming Connection Management, Error and Flow control mechanism	2-Understand
CO4	Demonstrate routing protocols and mechanisms	2-Understand
CO5	Apply concepts of framing, error detection and control at data link layer	3-Apply

COURSE CONTENTS

Unit I	Introduction to Computer Network	(08hrs)	COs Mapped - CO1

Introduction
Definition, Goals and applications of networks, **Types of Networks**: LAN, MAN, WAN, Wireless networks, **Network Architectures**: Client-Server, Peer To Peer, Hybrid .Protocol, Design issues for the network layers. **Network Models**: The OSI reference model, TCP/IP Model
Network Topologies and design: Network hardware devices: Bridge, Switch, Router, Gateway, Access Point.
Cast: Unicast, Multicast, Broadcast, Types of transmission medium, Signal transmission and **Line coding scheme**: Manchester and Differential Manchester encoding, Frequency Hopping(FHSS) , Direct Sequence Spread Spectrum (DSSS)
Switching Techniques: Circuit, message and packet switching, Multiplexing.
Network Performance: Bandwidth and Latency, Delay and bandwidth product, High speed

networks and application performance needs.
Basic network Security Concepts: Need, attacks, Types of network security and tools.

Topics for Self Study **:** Network hardware devices: Bridge, Switch, Router, Gateway, Access Point

Unit II	Application Layer	(07hrs)	COs Mapped - CO2

Web and HTTP, Web Caching , DNS ,Email: SMTP, MIME, POP3, Webmail,
FTP, **TELNET**,
DHCP, SNMP
Basic Concepts of Data Compression and Cryptography

UnitIII	Transport Layer	(07hrs)	COs Mapped - CO3

Process to Process Delivery, Services, Socket programming.
Elements of Transport Layer Protocols: Addressing, Connection establishment, Connectionrelease, Flow control and buffering, Multiplexing, Congestion Control.
Transport Layer Protocols: TCP and UDP, SCTP, RTP, Congestion control and quality of Service (QoS), Differentiated services
TCP and UDP for Wireless networks.

Topics for Self Study**:** Connection establishment, Connection release

nitIV	The Network Layer	(07hrs)	COs Mapped - CO4

IP Protocol: Classes of IP, IPv4, IPv6, Network Address translation, Sub-netting, CIDR.
Network layer Protocols: ARP, RARP, ICMP, and IGMP.
Network Routing and Algorithms: Static routing, Dynamic routing, Distance Vector Routing,Link State Routing, Path Vector.
Routing. Protocols: RIP, OSPF, BGP, and MPLS.
Routing in MANET: AODV, DSR, and Mobile IP.

Unit V	Data Link Layer	(07hrs)	COs Mapped - CO5

Design Issues: Services to network layer, Framing.
ARQ strategies: Error Detection and correction, Parity Bits, Hamming codes (11/12-bits) and CRC.
Flow Control Protocols: Unrestricted simplex, Stop and Wait, Sliding Window protocol.
WAN Connectivity: PPP and HDLC.
MAC Sub layer: Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, CSMA/CD, CSMA/CA, Binary Exponential Back-off algorithm,
Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 and IEEE 802.16 Standards.

Topics for self-study: CSMA/CD, CSMA/CA

Text Books

1. Kurose and Ross, "Computer Networking- A Top-Down Approach", Pearson, ISBN-10:0132856204
2. Andrew Tanenbaum "Computer Networks", Prentice Hall, ISBN:0-07-058408-7

Reference Books

1. Behrouz Forouzan, "Data Communication and Networking", McGraw Hill Publication, ISBN:0-07-058408-7
2. D. Comer, "Computer Networks and Internets", Pearson , ISBN: 0133587932
3. Behrouz Forouzan, "TCP/IP Protocol Suite", McGraw Hill Publication, ISBN 0-07-337604-3
4. Willam Stallings," Cryptography and Information Security: Principles and Practice", Pearson,4th edition, ISBN**:** 9789353942564

Guidelines for Continuous Comprehensive Evaluation of Theory Course	
Components for Continuous Comprehensive Evaluation	**Marks Allotted**
Quiz on Unit 1, Unit-2, Unit-4, Unit 5 (Quiz 15 marks each and will be converted to 15 Marks)	15
Theory assignment on Unit-3 (One Assignment on Unit III of 10 marks will be converted to 5 Marks)	5
Total	**20**

S.Y. B.Tech. Artificial Intelligence and Data Science Pattern 2022 Semester: III ADS222003:Discrete Mathematics		
TeachingScheme:	**CreditScheme:**	**ExaminationScheme:**
Theory:03hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSemExam:60 Marks**

PrerequisiteCourses: -FYE221001:Applied Mathematics-I

CourseObjectives:
- To understand the concepts of relations and functions
- Tounderstandthe useofpropositionallogicand numbertheory
- Tostudyconceptsof graph andtrees
- Tostudyalgebraicstructures

CourseOutcomes: Oncompletionofthecourse,studentswill beable to–

	CourseOutcomes	**Bloom'sLevel**
CO1	Solveproblemsusingpropositionallogicand numbertheory.	3-Apply
CO2	Userelationsor functions to solveproblems.	3-Apply
CO3	Applygraph theorytorepresent dataandsolveassociatedproblems.	3-Apply
CO4	Applytheconceptsoftreestogenerate minimumspanningtreeandprefix code.	3-Apply
CO5	Usealgebraic structuresto solveproblems.	3-Apply

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COURSECONTENTS

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UnitI	**PropositionalLogicandNumberTheory**	**(06hrs)**	**COs Mapped – CO1**

Propositional Logic: Propositional equivalences, predicates and quantifiers, applications ofpropositional logic, mathematical induction, recursive definition.
Number Theory: Introduction, divisibility and modular arithmetic, greatest common divisors, congruence, applications of number theory.

UnitII	**RelationsandFunctions**	**(08hrs)**	**COs Mapped - CO2**

Relations: Properties,n-aryrelations,representrelations,equivalencerelations,partialorderings,partitions, Hasse diagram, lattices, chains and anti-chains, closures of relations, transitive closure andWarshall'salgorithm.
Functions: Types of functions, properties, Pigeonhole principle.Recurrence relations,generatingfunctions.

Unit III	**GraphTheory**	**(08hrs)**	**COs Mapped - CO3**

Graphterminology,typesofgraphs,representationofgraphs,graphisomorphism,planargraphs,pathandcircuit,Eulerpathandcircuit,Hamiltonpathandcircuit,singlesourceshortestpath-Dijkstra's algorithm,maximumflowlabelingalgorithm.

Unit IV	Trees	(07hrs)	COs Mapped - CO4
Treesterminology,propertiesoftree,prefixcodesandHuffmancoding,cutsets,treetraversal, spanningtrees,minimumspanningtree,Kruskal'sandPrim'salgorithms.			
UnitV	AlgebraicStructuresandCodingTheory	(07hrs)	COs Mapped - CO5
Thestructureofalgebra,algebraicsystems,semigroups,monoids,groups,homomorphismand normalsubgroups,congruencerelations,rings,integraldomainsandfields,codingtheory.			

TextBooks
1. KennethH.Rosen,"DiscreteMathematicsanditsApplications",TataMcGraw-Hill,ISBN 978-0-07-288008-3   2. C.L. Liu,ElementsofDiscreteMathematics, TataMcGraw-Hill, ISBN10:0-07-066913-9   3. BernardKolman,RobertC.Busby andSharonRoss,"DiscreteMathematicalStructures",Prentice-HallofIndia /Pearson, ISBN: 0132078457, 9780132078450.

Reference Books
1. N.Biggs,"DiscreteMathematics",3rdEd,OxfordUniversityPress,ISBN0 –19-850717–8   2. NarsinghDeo,"Graph with application toEngineeringand ComputerScience",PrenticeHall ofIndia,1990, 0 – 87692 –145 – 4.

GuidelinesforContinuousComprehensiveEvaluationofTheoryCourse		
Sr.No.	ComponentsforContinuousComprehensiveEvaluation	MarksAllotted
1	Quiz on Unit 1, Unit-2,Unit-4, Unit 5 (Quiz 15markseachandwillbeconvertedto15Marks)	15
2	Theoryassignment onUnit-3 (OneAssignmentonUnitIIIof 10marks will beconvertedto5Marks)	5
	Total	20

S. Y. B. Tech.Artificial Intelligence and Data Science **Pattern 2022 Semester: III** **ADS222004: Digital Electronics and Logic Design**			
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**	
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**	

Prerequisite Course:- FYE221007 : Fundamentals of Electronics Engineering

Companion Course:- ADS222008 Digital Electronics Lab

Course Objectives:
- To study logic minimization techniques
- To develop skills for design and implementation of combinational logic circuits
- To develop skills for design and implementation of sequential logic circuits

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Solve the problem of minimization using K Map and QuineMc-Clusky method of Boolean expression	3-Apply
CO2	Build combinational circuits using AND-OR logic	3-Apply
CO3	Build combinationalcircuits using SSI and MSI logic	3-Apply
CO4	Explain applications of Flip Flops, registers and shift registers	2-Understand
CO5	Develop sequential logic circuits using Flip Flops and MSI logic	3-Apply

COURSE CONTENTS

Unit I	**Logic Minimization Technique**	**(08hrs)**	**COs Mapped - CO1**

Signed Binary Number Representation: Signedmagnitude, 1's complement, 2's complement,Binary arithmetic,Boolean expression: sum of product and product of sum form, Don't care conditions, Minimization of Boolean expression using K-map(upto 4 variables)and QuineMc-Cluskymethod

Unit II	**Introduction to Combinational Circuits**	**(06hrs)**	**COs Mapped - CO2**

Introduction to combinational circuits,**Codes &Code converter :** BCD, Excess-3, Gray code, Half-adder, Full adder, Half subtractor, Full subtractor, Universal adder/subtractor, 4 bit binary adder (IC 7483), Look ahead carry generator, BCD adder

Unit III	**Combinational Logic Design**	**(06hrs)**	**COs Mapped - CO3**

Multiplexers, Cascading multiplexers, Demultiplexers, Encoder,Decoder, Implementation of Boolean expression using multiplexer, Demultiplexer,Comparators, Parity generator and Checker.
Programmable Logic Devices:ROM,PLA,PAL

Unit IV	**Introduction to Sequential Circuits**	**(08hrs)**	**COs Mapped - CO4**

Difference between Combinational and Sequential Circuits,**Flip-Flops:**SR, Concept of preset & clear, Clocked-SR, JK, Master slave JK flip flop, T, D,Edge triggered and level triggered flip flops, Truth tables and excitation tables
Registers, Shift registers, Bidirectional shift register, Ring counter, Twisted ring counter,Universal shift register

Unit V	Sequential Logic Design	(08hrs)	COs Mapped - CO5

Counters: Types – Synchronous and asynchronous counters
Asynchronous Counters: Modulus of the counter, Decade counter, Up, Down and Up/Down counters
Synchronous sequential circuit design, State diagram, State assignment, State table, State reduction, Design procedure, Sequence generator and detector

Text Books

1. R. P. Jain, "Modern Digital Electronics", Fourth Edition, Tata McGraw Hill,ISBN 978-0-07-06691-16
2. Moris Mano, "Digital Logic and Computer Design", Second Edition, Pearson, ISBN: 978-8177584097

Reference Books

1. John Yarbrough, "Digital Logic applications and Design", FourthEdition, Thomson Publication , ISBN:978-8131500583
2. Malvino, D.Leach "Digital Principles and Applications", Sixth Edition,Tata McGraw-Hill, ISBN: 978-0070601758

Guidelines for Continuous Comprehensive Evaluationof Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit2, Unit 3 (Quiz 15 marks each and will be converted to 15 Marks)	15
2	Theory assignment on Unit 4, Unit 5 (OneAssignment each on Unit 4 and Unit 5 of 10 marks will be converted to 5 Marks)	5
	Total	**20**

S. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: III** **ADS222005:Programming Paradigms and Java Programming**	

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	**03**	**Continuous Comprehensive** **Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses:-FYE221010:Programming in C, FYE221011:Programming in CPP

Companion Course:- ADS222009: Programming Paradigms and Computer Network Lab

Course Objectives:
- To understand principles of programming paradigms
- To learn Object Oriented Programming (OOP) principles in Java programming
- To be familiar with the basic concepts of logical and functional programming language

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Remember and describe various programming paradigms	2-Understand
CO2	Make use of appropriate data types and control structures in Java to solve a given problem	3-Apply
CO3	Apply object oriented constructs in Java	3-Apply
CO4	Make use of exception handling and multithreading in Java	3-Apply
CO5	Compare and contrast Functional and Logic programming	4-Analyze

COURSE CONTENTS

Unit I	**Introduction to Programming Paradigms**	**(05hrs)**	**COs Mapped - CO1**

Language standardization: Proprietary and consensus,
Programming paradigms- Procedural, Object oriented, Functional, Logic
Properties of data types, objects, Scalar data types, Composite data types, Programming language syntax,
Stages in translation: analysis of the source program, synthesis of the object program.

Unit II	**Introduction to Java programming**	**(07hrs)**	**COs Mapped - CO2**

History and features of Java, Java Virtual Machine
Data Types: Signed vs. unsigned, User defined vs. primitive Data types, pointers
Arrays: One dimensional array, Multi-dimensional array, Alternative array declaration statements
Decision Making: if, else if, nested if, switch, Nested control structures: Syntax, semantics, pitfalls
Iterative Control Structures: while, do-while, for, the 'for- each': Syntax, semantics, pitfalls
Jump Statements :break and continue
String Handling: String classes and methods.
Comparison of Java and C++

Unit III	Object Oriented Programming in Java	(08hrs)	COs Mapped - CO3

Classes and Methods: Review of object oriented programming, objects, classes.
Assigning object reference variables, Introducing methods, constructors, Garbage collection, finalize() method
Inheritance: Member access and inheritance, Super class references, Using 'super' to call super class constructer, Creating a multilevel hierarchy, Method overriding, Dynamic method - dispatch, Using abstract classes
Packages and Interfaces: Defining a package, Finding packages, Access protection, Importing packages, Interfaces.
Comparison of Java and C++

Unit IV	Multithreading and Exception Handling using Java	(08hrs)	COs Mapped - CO4

Exception Handling: Types of Exceptions, Uncaught exceptions, Using try-catch, Multiple catch clauses, Nested try statements, Built-in exceptions, and Chained exceptions.
Multithreading in Java: Thread priorities, Synchronization, Messaging, Main thread, Creating a thread, Creating multiple threads.

Unit V	Logical and Functional Programming Languages	(08 hrs)	COs Mapped - CO5

LISP: Understanding symbol manipulation, Basic LISP functions, Definitions, predicates,
Conditionals and scoping, Recursion and iteration, Properties list arrays and access functions, Using lambda definitions, Printing, Reading and atom manipulation
Prolog: Introduction, Syntax and semantics of prolog programs, Lists, Operators, Arithmetic, Using structures.

Text Books
1. T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation‖", Fourth Edition, PHI, ISBN 81-203-2035-2
2. Herbert Schildt, "The Complete Reference Java", Ninth Edition, Tata McGraw Hill, ISBN: 978-0-07-180856-9
3.Ivan Bratko ,"Prolog programming for Artificial Intelligence", Wesley publishers Limited, ISBN10: 0321417461 · ISBN13: 978-0321417466
4.Winston P.,Klaus B., Horn P.,"LISP", Third Edition Pearson education, ISBN:81-7808-155-5

Reference Books
1. Carlo Ghezzi, Mehdi Jazayeri,"Programming Language Concepts", Third Edition, Wiley Publication ISBN 978-81-265-1861-6.
2. Deugo, "Java Gems", Cambridge University Press, ISBN 0521648246

Guidelines for Continuous Comprehensive Evaluationof Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit-2, Unit-4, Unit 5 (Quiz 15 marks each and will be converted to 15 Marks)	15
2	Theory assignment on Unit-3 (One assignment on Unit III of 10 marks will be converted to 5 Marks)	5
	Total	**20**

S. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022   Semester: III
ADS222006: Emotional Intelligence

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :01 hrs/week	**01**	**Term Work: 25**

Prerequisite Courses, if any: -Communication Skill

Course Objectives:
- To understand use of Emotional Intelligence.
- To acquire knowledge of Emotional Intelligence and implement it at workplace
- To DevelopEmotional Intelligence in personal manner

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Outline the emotional and social competencies that make up Emotional Intelligence	2-Understanding
CO2	Classify how you can work to enhance your Emotional Intelligenceto increase your performance at work	2-Understanding
CO3	Compare what Emotional Intelligenceis and what it is NOT	2-Understanding
CO4	Analyze how basic human emotions and how they impact on decision making and on developing relationships	3-Apply
CO5	Distinguish models of Emotional Intelligenceand what they mean regarding your personal development. Assess how you react in situations with a particular focus on how your feelings and emotions impact upon your behavior.	3-Apply

COURSE CONTENTS

Unit I	Introduction to Emotional Intelligence	(03hrs)	COs Mapped - CO1

Introduction to Emotional Intelligence(EI), Importance of EI, difference between Emotional Quotient and Intelligent Quotient, list of EICompetencies, Benefits of EI, EI in Health and well being, role of EI in personality development.

NPTEL Course: Introduction to Emotional Intelligence

Unit II	Emotions Methodology	(02hrs)	COs Mapped - CO2

Function of emotions, hierarchy of the human brain, levels of the brain work, expression of emotion depends upon the context.

NPTEL Course: Emotions Methodology

Unit III	Emotional Intelligence Models	(02hrs)	COs Mapped – CO3

Effectiveemotional information, meaningful ways of EI, EIand cognitive intelligence, working with the emotional climate, EI feedback, advantages and disadvantages of EI.

NPTEL Course: Emotional Intelligence Models			
Unit IV	**Emotional Intelligence at workplace**	**(03hrs)**	**COs Mapped – CO4**
Pioneers in the field of EI, components of the EI, competency framework, inner world and outer world components, abilities of EI, actions you can take to work with EI, measurement of EI. Managing stress, suicide prevention, spirituality and meditation.			
NPTEL Course: Emotional Intelligence at workplace			
Unit V	**Development of Emotional Intelligence**	**(02hrs)**	**COs Mapped – CO5**
Emotional Intelligence for growth, development ofEI, aspect of EI, working with EI, Application of EI.			
NPTEL Course: Development of Emotional Intelligence			

Text Books
1. Emotional Intelligence: For a Better Life, success at work, and happier relationships. Improve Your Social Skills, Emotional Agility and Discover Why ... IQ. (EQ 2.0) (Brandon Goleman Collection) Paperback – June 17, 2019, ISBN-13 978-1077972131.

Reference Books
1. Daniel Goleman, "Emotional Intelligence Reader's Guide", Random House Publishing Group, ISBN 10- 9780553383713.

MOOC Courses
• **https://alison.com/topic/learn/79339/an-introduction-to-the-course-on-developing-your-emotional-intelligence** • **https://alison.com/topic/learn/79349/the-development-and-function-of-emotions** • **https://alison.com/topic/learn/79355/emotional-intelligence-models-learning-outcomes** • **https://alison.com/topic/learn/79361/develop-your-emotional-intelligence-learning-outcomes** • **https://alison.com/topic/learn/79339/an-introduction-to-the-course-on-developing-your-emotional-intelligence**

Guidelines for Term work Assessment
Termwork Assessment shall be based on overall performance of a student. Rubrics for Assessment: R1- Multiple Choice Questions (05) R2- Case Study based on Emotional Intelligence (10) R3- Assignments and Poster Presentation (10).

S. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: III** **ADS222007: Data Structures Lab**	

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 04 hrs/week	**02**	**Term Work: 25 Marks** **Practical Exam : 50 Marks**

Prerequisite Courses:- FYE221010: Programming in C, FYE221011: Programming in CPP

Companion Course:- ADS222001: Fundamentals of Data Structures

Course Objectives:
- To understand basic concepts and terminology of algorithms and data structures
- To study data structures arrays, linked lists, stack and queues
- To learn searching and sorting methods

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Describe the fundamental concepts and terminology of data structures and algorithms, including arrays, linked lists, stacks, queues and searching and sorting algorithms	2-Understand
CO2	Demonstrate the ability to choose and implement appropriate data structures such as Array, linked list, stack and queue to solve a given problem	3-Apply
CO3	Implement algorithms for array and linked list processing such as insertion, and deletion using C++	3-Apply
CO4	Use stack and / or queue to solve the given problem	3-Apply
CO5	Compare different searching and sorting algorithms based on their performance, strengths, and limitations.	3-Apply

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**COs Mapped**

1	**Set operations:** Write a menu driven C++ program to store sets for students' names participating in different events in Equinox such as Coding contest, Project competition, Paper Presentation, MasterMind etc.
	   1. Find out participants who have participated in Coding and Project both
	   2. Find out participants who have participated in Coding or Project competition or both or Mastermind
	   3. Find out participants who have participated in Coding but not in Master mind
	 Find out participants who have participated in all events
		CO1,CO2, CO3

2	**Knight's tour:** The problem is to move the knight, beginning from any given square on the chessboard, in such a manner that it travels successively to all 64 squares, touching each square once and only once. It is convenient to represent a solution by placing the numbers 1,2, ...,64 in the squares of the chessboard indicating the order in which the squares are reached. Note that it is not required that the knight be able to reach the initial position by one more move; if this is possible the knight's tour is called re-entrant. One of the more ingenious methods for solving the problem of the knight's tour is that given by J. C. Warnsdorff in 1823. His rule is that the knight must always be moved to one of the squares from which there are the fewest exits to squares not already traversed. Write a C++ program to implement Warnsdorff's rule and show it graphically. OR **Random walk**: A (drunken) cockroach is placed on a given square in the middle of a tile floor in a rectangular room of size n x m tiles. The bug wanders (possibly in search of an aspirin) randomly from tile to tile throughout the room. Assuming that it may move from his present tile to any of the eight tiles surrounding it (unless it is against a wall) with equal probability, how long will it take him to touch every tile on the floor at least once? Write a C++ program to graphically show a random walk of a (drunken) cockroach and find the no of moves made.	CO1,CO2, CO3

3	**String Operations:** Write a menu driven C++ program with a class for String. Write functions
	   1. To determine the frequency of occurrence of a particular character in the string.
	   2. Extract a new string from original string by accepting starting position and length
	   3. To accept any character and return the string with by removing all occurrences of a character accepted
	   4. To make an in-place replacement of a substring w of a string by the string x. Note that w may not be of same size that of x
	   5. To check whether given string is palindrome or not
		CO1,CO2, CO3

4	**Sparse Matrix:** Write a menu driven C++ program with class for Sparse Matrix. Write functions to perform Sparse Matrix operations as listed below
	   1. Read sparse matrix
	   2. Display sparse matrix
	   3. Add two sparse matrices
	   4. Find transpose using Simple transpose algorithm
	   5. Find transpose using Fast transpose algorithm
	Compare complexity of simple and fast transpose using counter.
		CO1,CO2, CO3

5	**Polynomial operations:** Write a menu driven C++ program with class for single variable polynomial and write functions to perform following polynomial operations using arrays
	    1. Read polynomial
	    2. Display polynomial
	    3. Add two polynomials
	 You can try above polynomial operation using Linked list
		CO1,CO2, CO3

6	**Linked list operations:** Create a linked list of names and birthdays of students. Write a menu driven C++ program to perform following operations
	    1. Insert name and birthday of new student
	    2. Delete a student entry
	    3. Display a happy birthday message for whom today (based on system date) is birthday
	    4. Display list of students with their birthdays
		CO1,CO2, CO3

7	**Appointment Management:** Write a menu driven C++ program for storing appointment schedules for the day. Appointments are booked randomly using linked lists. Set start and end time for visit slots. Write functions for 1. Display free slots 2. Book appointment 3. Cancel appointment (check validity, time bounds, availability etc) 4. Sort list based on time 5. Sort list based on time using pointer manipulation	CO1,CO2, CO3
8	**Expression conversion**: Write a menu driven C++ program for expression conversion and evaluation 1. infix to prefix 2. prefix to postfix 3. prefix to infix 4. postfix to infix 5. postfix to prefix	CO1,CO2, CO4
9	**String operations:** A palindrome is a string of characters that's identical when read in forward and backward direction. Typically, punctuation, capitalization, and spaces are ignored. For example, "1.Poor Dan is in a droop!!" is a palindrome, as can be seen by examining the characters "poordanisinadroop" and observing that they are identical when read forward and backward directions. One way to check for a palindrome is to reverse the characters in the string and compare them with the original-in a palindrome, the sequence will be identical. Write C++ program with functions using Standard Template Library (STL) stack- 1. To print original string followed by reversed string using stack 2. To check whether given string is palindrome or not	CO1,CO2, CO4
10	**Simulation of pizza parlor**: Pizza parlor accepting maximum M orders. Orders are served on a first come first served basis. Order once placed cannot be canceled. Write C++ program to simulate the system using simple queue or circular queue	CO1,CO2, CO4

11	**Sorting:** Write a C++ menu driven program to store the percentage of marks obtained by the students in an array. Write function for sorting array of floating point numbers in ascending order using 1. Selection Sort 2. Bubble sort 3. Insertion sort 4. Shell Sort 5. Quick sort 6. Radix sort 7. Display top five scores Implement 4 methods of sorting. Provide choice to user to take input from user or using random numbers. Use Standard Template Library (STL) sort function for above data.	CO1, CO5
12	**Searching:** Write a C++ program to store roll numbers of students in an array who attended online lectures in random order. Write function for searching, whether a particular student attended lecture or not using 1. Linear search 2. Binary search 3. Jump search compare the searching methods based on complexities of an algorithm Provide choice to user to take input from user or using random numbers Use Visual C++ compiler to compile and execute the program.	CO1, CO5
13	A list of data representing various environmental parameters such as temperature, humidity, pollution levels, etc is maintained using appropriate data structure. Write a C++ program that uses data structures to perform the following operations: 1. Find the maximum and minimum values of each parameter in the list. 2. Calculate the average value of each parameter in the list. 3. Sort the list in ascending order of any one parameter. 4. Find the highest and lowest values of any one parameter that are considered safe for the environment. 5. Calculate the impact of the parameter values on the environment based on certain pre-defined criteria. 6. Analyze the impact of the environmental parameters on the health and safety of the society. 7. Ensure that the program follows ethical and professional practices, such as ensuring the privacy and security of the data. You should implement the program using appropriate data structures that take into account the size and complexity of the data, and demonstrate an understanding of the societal and environmental issues related to the data. Your program should also demonstrate an understanding of the impact of the parameter values on the environment, and the need for sustainable development. Finally, your program should adhere to ethical principles and professional practices, such as ensuring the confidentiality, privacy, and security of the data	CO1, CO5

Mini Project		
	Develop a mini project in a group Following is the sample problem statements based on concepts learned in the course	CO1 to CO5
	1. Implement an efficient system to monitor and analyze sound pollution levels in a given area. The system should be able to store and process large amounts of sound data, and provide relevant insights and visualizations to help identify areas of high sound pollution.	
	The system should have the following functionalities:	
	• Data Collection: Collected sound data from various sources, such as sound sensors or microphones is stored in a structured format as a file system.	
	• Data Processing: The system should be able to process the collected data to identify patterns and trends in sound pollution levels. This could involve tasks such as noise filtering, signal processing, and feature extraction.	
	• Data Analysis: The system should be able to analyze the processed data to provide insights into sound pollution levels in a given area. This could involve tasks such as trend analysis, outlier detection, and clustering.	
	• Visualization: The system should be able to provide relevant visualizations to help identify areas of high sound pollution. This could involve tasks such as heat map generation, time-series plotting, and spatial analysis.	
	The system should be designed to handle large volumes of sound data efficiently and provide real-time or near-real-time analysis and visualization. The implementation of the system should be efficient in terms of space and time complexity, and should be scalable to handle increasing volumes of data.	
	Students are free to implement any other relevant mini project problem statement as follows.	
	2. Operations on Big number	
	3. Appointment management	
	4. Phone book operations	
	5. Sorting methods simulation and comparison	

Additional programming problems for practice		
1	**Binary Number operations:** Write a C++menu driven program for storing binary numbers using doubly linked lists. Write functions- 1. To compute 1's and 2's complement 2. Add two binary numbers	CO1, CO2, CO3
2	**GLL:** Write C++ program to realize set using generalized linked list e.g. A ={ a, b, {c, d, e, { }}, {f, g}, h, i, {j, k}, l, m}. Store and print as set notation.	CO1, CO2, CO3

3	**Eight Queens:** A classic problem that can be solved by backtracking is called the Eight Queens problem, which comes from the game of chess. The chess board consists of 64 squares arranged in an 8 by 8 grid. The board normally alternates between black and white squares, but this is not relevant for the present problem. The queen can move as far as she wants in any direction, as long as she follows a straight line, Vertically, horizontally, or diagonally. Write C++ program with a recursive function for generating all possible configurations for 8-queen's problem.	CO1, CO2, CO4
4	**DEQUE:** A double-ended queue (deque) is a linear list in which additions and deletions may be made at either end. Obtain a data representation mapping a deque into a one-dimensional array. Write C++ menu driven program to simulate deque with functions to add and delete elements from either end of the deque. Also implement using STL	CO1, CO2, CO4

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.
Use of open source software is to be encouraged.
Operating System recommended:- Linux or its derivative
Programming tools recommended: - Open Source line gcc/g++ (Visual C++ compiler for few assignments and note the difference)

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on the overall performance of a student.
Assessment of each laboratory assignment shall be based on rubrics that include
R1- timely completion (10),
R2- understanding of assignment (10) and
R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)
Mini Project assessment will be based on Teamwork, Communication skill, Social relevance of mini project, Ethics followed.

S. Y. B. Tech. Artificial Intelligence and Data Science Pattern 2022 Semester: III ADS222008: Digital Electronics Lab		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term Work: 25 Marks** **Practical Exam: 25 Marks**

Prerequisite Courses:-FYE221007: Fundamentals of Electronics Engineering

Companion Course:-ADS222004 Digital Electronics and Logic Design

Course Objectives:
- To study logic minimization techniques
- To develop skills for design and implementation of combinational logic circuits
- To develop skills for design and implementation of sequential logic circuits

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Solve the problem of minimization using K Map and QuineMc-Clusky method of Boolean expression	3-Apply
CO2	Build combinational circuits using AND-OR logic	3-Apply
CO3	Build combinationalcircuits using SSI and MSI logic	3-Apply
CO4	Explain applications of Flip Flops, registers and shift registers	2-Understand
CO5	Develop sequential logic circuits using Flip Flops and MSI logic	3-Apply

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**COs Mapped**
1.	To Realize Full Adder and Subtractor using logicgates	CO1,CO2
2.	Design and implement Code Converters-Binary to Gray and BCD to Excess-3	CO1,CO2
3.	Design and implement of BCD Adder using 4-bit Binary Adder (IC 7483)	CO1,CO2,CO3
4.	Realization of Boolean Expression using Multiplexer	CO3
5.	Design and implement twobit comparator using logic gates	CO1, CO2
6.	Design and implement Parity Generator and checker	CO1, CO2
7.	Realization of Boolean Expression using Encoder	CO3
8.	Realization of Boolean Expression using Decoder	CO3
9.	Implement 2 bit Ripple Counter using JK Flip Flop	CO4, CO5
10.	Design of Synchronous 2 bit Up/Down Counter using JK Flip Flop	CO1, CO4, CO5
11.	Design and implement Modulo-N counter using Decade Counter IC 7490	CO1, CO4,CO5
12.	Design and waplment Sequence generator and detector using JK Flip Flop	CO1, CO4, CO5
13.	Implement 3/4 bits shift registers using D Flip Flop	CO4
Guidelines for Laboratory Conduction		

1. Teacher will brief the given experiment to students its procedure
2. Apparatus and equipments required for the allotted experiment will be provided by the lab assistants using SOP
3. Students will perform the allotted experiment in a group (three/four students in each group) under the supervision of faculty and lab assistant
4. After performing the experiment students will check their output from the teacher

Guidelines for Student's Lab Journal

Write-up should include title, aim, steps of circuit designing (Block Diagram, Truth Table, K Map, Expression, Realization, Conclusion)

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on the overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include

R1- timely completion (10),

R2- understanding of assignment (10) and

R3- presentation/clarity of journal writing (10)

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech. Artificial Intelligence and Data Science Pattern 2022 Semester: III ADS222009: Programming Paradigms and Computer Networks Laboratory		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term Work:** 25Marks **Practical Exam:** 25Marks

Prerequisite Courses:- FYE221010 : Programming in C, FYE221011:Programming in CPP, FYE221001 : Applied Mathematics I

Companion Course: ADS222009:Programming Paradigms and Java Programming
ADS222002 Computer Networks

Course Objectives:
- To understand object-oriented concepts in Java such as data abstraction, encapsulation, inheritance, dynamic binding, and polymorphism
- To be familiar with functional and logical programming paradigm
- To understand basic concepts of Graphics Programming
- To know various algorithms for generating and rendering geometrical objects

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Demonstrate Object Oriented Programming features like inheritance, data abstraction, encapsulation, and polymorphism to solve various computing problems	2- Understand
CO2	Illustrate the use of exception handling and multithreading in Java	2-Understand
CO3	Compare and contrast Functional and Logic programming	2-Understand
CO4	Demonstrate basics of LAN and functions of application layer, transport layer and network layer	2-Understand
CO5	Apply concepts of framing, error detection and control at Data link Layer	2-Apply

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**COs Mapped**
1	Write a JAVA program to create a base class "Person" with name and phone number as its attributes. Derive a class "Academic Performance" with Degree and percentage as its attributes from the "Person" class. Display both personal and academic information. Make use of constructor, default constructor, copy constructor and a destructor. **Also Derive a class "Sports performance" with sports-name and score as its attribute from the "Person" class. Display personal data along with information about scores obtained in the Sport event.**	**CO1**
2	A publishing company deals with marketing of books and audio cassettes. For each book and the audio cassette the company needs to record a title and price of publication. Also a page count should be recorded for each book and a play-time in minutes should be recorded for each cassette. Design a suitable class hierarchy. Write a menu driven program that instantiates the book and tape class, allows users to manipulate and display the information about books and cassettes. The program should catch exceptions and if an exception is	**CO1**

	caught, it should replace all the values of data members with zeroes.	
3	Write a JAVA program to create User defined exception to check the following conditions and throw the exception if the criterion does not met. a. User has age between 18 and 55 b. User stays has income between Rs. 50,000 – Rs. 1,00,000 per month c. User stays in Pune / Mumbai/ Bangalore / Chennai d. User has 4-wheeler Accept age, Income, City, Vehicle from the user and check for the conditions mentioned above. If any of the condition not met then throw the exception.	**CO1**
4	Write java program to create a super class called Figure that receives the dimensions of two dimensional objects. It also defines a method called area that computes the area of an object. The program derives two subclasses from Figure. The first is Rectangle and second is Triangle. Each of the sub class overridden area() so that it returns the area of a rectangle and a triangle respectively	**CO1**
5	Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication	**CO2**
7	Consider a database of facts that describe parent relationships as well as gender relationships. The predicate parent (john,ann) is interpreted as: "John is a parent of Ann". The predicate male (john) is interpreted as: "John is a man". The predicate female (ann) is interpreted as: "Ann is a woman". Write a Prolog predicate half sister (X,Y) that is true if X is Y's half-sister.	**CO3**
8	Setup a WAN which contains wired as well as wireless LAN using apacket tracer tool. Demonstrate transfer of a packet from LAN1 (wired LAN) to LAN2(Wireless LAN).	**CO4**
9	Write a program for DNS lookup. Given an IP address as input, it should return URL and vice-versa.	**CO4**
10	Write a client-server programs using TCP socket for wired network to - a. Say Hello to Each other b. File transfer c. Calculator	**CO4**
11	Write a program to demonstrate sub-nets and find the subnet masks	**CO4**
12	Write a program for error detection and correction for 7/8 bits ASCII codesusing Hamming Codes or CRC	**CO5**
Guidelines for Laboratory Conduction		

Guidelines for Laboratory Conduction

Use of open source software is encouraged.
1. Operating System recommended :- 64-bit Open source Linux or its derivative
2. Programming tools recommended: - Open Source Java Programming tool
3. Simulation tools recommended : Packet tracer tool
   Students shall use popular Java compilers/IDE such as GNU/Javac/Eclipse/Rose/SmartEiffel

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Software and Hardware requirements, Theory- Concept in brief, algorithm, flowchart, Mathematical model (if applicable) and conclusions. Program codes with sample output of all performed
Assignments are to be submitted as softcopy.

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on the overall performance of a student.
Assessment of each laboratory assignment shall be based on rubrics that include
R1- timely completion (10),
R2- understanding of assignment (10) and
R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

S. Y. B. Tech. Artificial Intelligence and Data Science Pattern 2022 Semester: III ADS222010: Python Programming Lab		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 2 hrs/week	**01**	**Term Work : 25 Marks**

Prerequisite Courses:- FYE221010: Programming in C

Course Objectives:
- To understand core python programming
- To understand python looping, control statements and string manipulations
- To understand the basic concepts of functions

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Use the core concepts to write a python program	3-Apply
CO2	Apply control structure and loops to build a solution for a given problem	3-Apply
CO3	Develop python program for string manipulation	3-Apply
CO4	Build a solution for a given problem using lists, sets, tuples, dictionaries	3-Apply
CO5	Develop programs using functions	3-Apply

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COURSE CONTENTS

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Installation of Python IDEs: PyCharm/Eclipse/PyDev

Data-types in Python

Variables in Python

Identifiers, Data Types, Constants, Input / Output, Operators (Arithmetic, relational, logical, bitwise), Expressions, Precedence and Associativity, Type conversions

Taking User Input (Console)

Conditional algorithmic constructs: if, if-else, nested if-else, cascaded if-else and switch statement

Iterative algorithmic constructs: 'for', 'while' statements, nested loops, Continue, break statements

Function: definition, call, variable scope and lifetime, the return statement. Defining functions, Lambda or anonymous function

Arrays: One- dimensional, multidimensional array, character arrays (Strings).

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Write a python program that accepts seconds as input of type integer. The program should convert seconds in hours, minutes and seconds. Output should like this : Enter seconds: 12200 Hours: 3 Minutes: 23 Seconds: 20	**CO1**
2	**Conditional Structures** The marks obtained by a student in 3 different subjects are input by the user. Python program should calculate the average marks obtained in 3 subjects and display the grade. The student gets a grade as per the following rules: Average Grade 90-100 O 80-89 A 70-79 B 60-69 C 40-59 D 0-39 F	**CO2**
3	**Control structures** Floyd's triangle is a right-angled triangular array of natural numbers as shown below: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 Write a python program to print the Floyd's triangle	**CO2**
4	**String** Write a python program that accepts a string to setup a password with following requirements: - The password must be at least eight characters long - It must contain at least one uppercase letter - It must contain at least one lowercase letter - It must contain at least one numeric digit The program checks the validity of password.	**CO3**
5	**List** Write a python program to - Find the sum and average of given numbers using lists - Display elements of list in reverse order - Find the minimum and maximum elements in the lists	**CO4**
6	**Tuple** Write a Python program to sort a tuple by its float element. Sample data: [('item1', '13.10'), ('item2', '17.10'), ('item3', '25.3')] Expected Output: [('item3', '25.3'), ('item2', '17.10'), ('item1', '13.10')]	**CO4**

7	**Dictionary** Write a python program to read string from user and create a dictionary having key as word length and value is count of words of that length. For example, if user enters 'I scream you scream we all scream for ice cream' Word Word length I 1 scream 6 you 3 scream 6 we 2 all 3 scream 6 for 3 ice 3 cream 5 The content of dictionary should be {1:1, 6:3, 3:4, 2:1, 5:1}	**CO4**
8	**Set** Write a python program for operations on set	**CO4**
9	**Function** Write a function in python to display the elements of list thrice if it is a number and display the element terminated with '#' if it is not a number. Suppose the following input is supplied to the program: ['23','MAN','GIRIRAJ', '24','ZARA'] The output should be 232323 MAN# GIRIRAJ# 242424 ZARA#	**CO5**

Mini Project

10	Develop a mini project in a group based on Python programming concepts and design thinking	**CO1 to CO5**

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.
Operating System recommended:- Linux or its derivative
Use the concepts of design thinking in mini project.

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form.

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on the overall performance of a student.
Assessment of each laboratory assignment shall be based on rubrics that include
 R1- timely completion (10)
 R2- understanding of assignment (10)
 R3- Use Coding standards, proper documentation, neatness of writeup (10) – 5 marks for coding standards and documentation and 5 marks for neatness of write up

Text Books
1. Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press, ISBN 13: 978-0-19-948017-6 2.
2. R. Nageswara Rao, "Core Python Programming", Dreamtech Press, ISBN-13: 978-9386052308
Reference Books
1. R. G. Dromey, "How to Solve it by Computer", Pearson Education India, ISBN-13: 978-8131705629
2. Maureen Spankle, "Problem Solving and Programming Concepts", Pearson, ISBN-13: 978-0132492645

S.Y.B.Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: IV** **SMH222111: Applied Mathematics-III**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03hrs/week **Tutorial:01hr/week**	**03** **01**	**Continuous Comprehensive Evaluation:20Marks** **InSem Exam: 20Marks** **EndSemExam:60Marks** **Tutorial:25Marks**

Prerequisite Courses:- Applied Mathematics-I

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand basic concept of Statistic	2-Understand
CO2	Understand basic concept of probability distribution	2-Understand
CO3	Apply the basic concepts of statistics to real life problems	3-Apply
CO4	Apply the basic concepts of probability distribution theory to real life problems	3-Apply
CO5	Analyze real life problems by using theory of statistics and Probability distribution	4-Analyze

COURSE CONTENTS			
UnitI	**Descriptive Measures**	**(08hrs+2hrsTutorial)**	**COs Mapped - CO1, CO2, CO3**

Measures of central tendency (Mean, Median, Mode), Measures of dispersion (Variance, Standard Deviation, Range), coefficients of variation, Moments, Skewness and Kurtosis.

Unit II	**Random Variable & Distribution Functions**	**(08hrs+2hrsTutorial)**	**COs Mapped -CO1, CO2, CO3**

Random Variable, Distribution functions (Continuous and discrete), Properties of distribution function, Probability mass function (p.m.f.), Probability density function (p.d.f.) and Cumulative distribution function (Continuous and discrete).

Unit III	**Mathematical Expectation and Generating Function**	**(08hrs+2hrsTutorial)**	**COs Mapped - CO3, CO4, CO5**

Mathematical Expectation, Properties of expectation, Moment Generating Function

Unit IV	Probability Distributions	(08hrs+2hrsTutorial)	COsMapped - CO4, CO5
Discrete distributions: Geometric, Binomial, Poisson, Uniform Distribution Continuous distribution: Normal distribution, Standard Normal, Uniform.			
Unit V	Correlation and Regression	(08hrs+2hrsTutorial)	COs Mapped - CO1, CO2
Covariance, Concept of correlation, Karl Pearson's Coefficient of Correlation, Rank Correlation coefficient, Spearman's rank Correlation coefficient. Regression: Lines of Regression, Regression coefficients.			
TextBooks			
1. B.V.Ramana,"Higher Engineering Mathematics", TataMcGraw-Hill. 2. B.S.Grewal,"Higher Engineering Mathematics",Khanna Publication,Delhi. 3. AdvancedEngineeringMathematics,7e,bypeterV.O‟Neil(ThomsonLearning) 4. IntroductiontoProbabilityandStatistics forEngineersandScientists,5e, bySheldonM.Ross(ElsevierAcademicPress)			
ReferenceBooks			
1. Erwin Kreyszig,"Advanced Engineering Mathematics",WileyEastern Ltd. 2. P.N.Wartikar and J.N.Wartikar,"Applied Mathematics"(VolumesI and II), Pune Vidyarthi Griha Prakashan, Pune. 3. AdvancedEngineeringMathematics,2e,by M.D.Greenberg(PearsonEducation).			

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr.No.	Components for Continuous Comprehensive Evaluation	Marks Alloted
1	Assignments (Total3Assignment, Unit I and II 20marks,Unit III and IV20marks and UnitV- 10marks &50markswillbeconvertedto10Marks)	10
2	Tests on each unit using LearniCo (Each test for15 Marks and total will be converted out of 10Marks)	10

List of Tutorial Assignments		
Sr.No.	Title	CO Mapped
1	Examples on measures of central tendency and measures of dispersion	CO1,CO2, CO3
2	Examples on Probability density function (p.d.f.) and Cumulative distribution function (Continuous and discrete).	CO1,CO2, CO3
3	Examples on Probability mass function (p.m.f.) and Probability density function (p.d.f.)	CO1,CO2
4	Examples on Cumulative distribution function (Continuous and discrete).	CO1,CO2
5	Solve problems on measures of central tendency using MATLAB	CO1,CO2, CO3,CO4
6	Solve problems on measures of dispersion using MATLAB	CO1,CO2, CO3,CO4
7	Examples on Mathematical Expectation, Properties of expectation,	CO1,CO2, CO3

8	Examples on Moment generating function	CO1,CO2, CO3
9	Examples on Geometric, Binomial, Poisson, Uniform Distribution	CO3, CO4,CO5
10	Examples on Normal, Standard Normal &Uniform distribution	CO3, CO4,CO5
11	Examples on Covariance, Karl Pearson's Coefficient of Correlation, Rank Correlation coefficient, Spearman's rank Correlation coefficient.	CO4,CO5
12	Examples on Lines of regression, Regression coefficients.	CO4,CO5

Guidelines for Tutorial/Termwork Assessment		
Sr.No.	**Components for Tutorial/Termwork Assessment**	**Marks Allotted**
1	Assignment on Computational Software	5
2	Tutorial (Each tutorial carries 15marks)	15
3	Attendance (Above95%:05Marks,below75%: 0Marks)	5

S. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: IV
ADS222012: Advanced Data Structures

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses:- ADS222001: Fundamentals of Data structures, ADS222003:Discrete Mathematics

Companion Course:- ADS222017: Advanced Data Structures Laboratory

Course Objectives:
- To understand basic concepts of non linear data structures such as trees, graphs
- To study the concepts of hash table and files
- To learn advanced data structures such as indexing techniques and multiway search trees

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Make use of non-linear data structures such as graph and trees to solve a given problem	3-Apply
CO2	Use different representations of symbol table	3-Apply
CO3	Apply the hash table and it's collision resolution methods and different file handling techniques	3-Apply
CO4	Use efficient indexing techniques and multiway search trees to store and maintain data	3-Apply
CO5	Analyze an algorithm used for solving a given problem	4-Analyze

COURSE CONTENTS

Unit I	Graphs	(08 hrs)	COs Mapped - CO1, CO5

Graph- Basic Concepts, Storage representation- Adjacency matrix, Adjacency list, Adjacency multi list Traversals-Depth First Search (DFS) and Breadth First Search(BFS)
Spanning Tree - Connected components, Minimum spanning Tree, Greedy algorithms- Prim's and Kruskal's for MST
Dikjtra's Single source shortest path, Algorithm for Topological ordering
Self Study-Data structure used in Webgraph and Google map.

Unit II	Trees	(08 hrs)	COs Mapped - CO1, CO5

Trees- Basic terminology, General tree and its representation, Representation using sequential and linked organization**, C**onverting tree to binary tree, Types of trees
Binary tree- Properties, ADT, Representation using sequential and linked organization, Binary tree traversals (recursive and non-recursive)- inorder, preorder, postorder, Depth first and breadth first search, Operations on binary tree, Formation of binary tree from given traversals,
Applications of Binary trees

Binary Search Tree (BST) - Concept, Definition, Comparison with binary tree, BST operations, applications of BST Threaded binary tree, Expression tree, Huffman Tree (Concept and Use), Decision Tree, Game tree.			
Unit III	**Symbol Table**	**(07 hrs)**	**COs Mapped – CO2, CO5**
Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming **Height Balanced Trees**- AVL tree. Red-Black Tree, Splay Tree.			
Unit IV	**Hash tables and Files**	**(07 hrs)**	**COs Mapped – CO3, CO5**
Hash table Concepts-Hash function, bucket, Collision, Probe, Synonym, Overflow, Open hashing, Closed hashing, Perfect hash function, Load density, Full table, Load factor, Rehashing, Basic operations, Issues in hashing **Hash functions-** Properties of good hash function, Division, Multiplication, Extraction, Mid-square, folding and universal **Collision resolution strategies-**Open addressing and Chaining, Hash table overflow- Open addressing and Chaining, Closed addressing and Separate chaining. **Files-**Concept, Need, Primitive operations. Sequential file organization, Direct access file, Indexed sequential file organization-Concept and Primitive operations **Self Study**- SkipList- Representation, Searching.			
Unit V	**Indexing and Multiway Trees**	**(06 hrs)**	**COs Mapped – CO4, CO5**
Indexing and Multiway Trees- Indexing, Indexing techniques-Primary, Secondary, Dense, Sparse Multiway search trees, B-Tree- Insertion, Deletion, B+ Tree - Insertion, Deletion, Use of B+ tree in Indexing **Heaps**- Concept, Insert, Delete operation, Heap sort, Heap as a Priority Queue. **Self Study**- Trie Tree			
Text Books			
1. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786 2. M Folk, B Zoellick, G. Riccardi, "File Structures", Pearson Education, ISBN:81-7758-37-5			
Reference Books			
1. Sartaj Sahani, "Data Structures, Algorithms and Applications in C++", Second Edition, University Press, ISBN: 9788173715228 2. G A V Pai, "Data Structures and Algorithms", McGraw-Hill Companies, ISBN:9780070667266			

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit-2, Unit-3 (Quiz 10 marks on each unit and will be converted to 10 Marks)	10
2	Theory assignment on Unit- 4 & 5 (10 marks assignment on unit 4 and 5 each and that will be converted in to 10 Marks)	10
	Total	**20**

S. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: IV** **ADS222013 : Operating Systems**			
Teaching Scheme:		**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week		**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses:- ADS222001**:**Fundamentals of Data Structures

Companion Course:- ADS222018: Operating Systems Lab

Course Objectives:
- To understand operating system services, types of operating systems and shell scripts
- To study process scheduling algorithms and multithreading techniques
- To get acquainted with the concepts of synchronization, deadlock prevention and avoidance algorithms
- To learn concepts of memory management and I/O management techniques
- To introduce Linux operating systems

Course Outcomes: On completion of the course, students will be able to

	Course Outcomes	Bloom's Level
CO1	Explain operating system services, types of operating systems and basic shell commands	2- Understand
CO2	Illustrate the concept of process scheduling algorithms to solve scheduling problems	2- Understand
CO3	Compare algorithms for deadlock detection, prevention and avoidance	2- Understand
CO4	Use algorithms for page replacement and I/O management	3- Apply
CO5	Describe Linux commands and utilities such as grep, tr, sed, awk	2- Understand

COURSE CONTENTS

Unit I	**Fundamental concepts of operating systems**	**(07 hrs)**	**COs Mapped - CO1**

Introduction, Operating systems services
Types of operating systems: Batch, Time-sharing, Network, Distributed and real time.
Operating system operations: Dual mode and multimode, System calls, Types of system calls.
Bash shell scripting: Basic shell commands and scripting language.

Unit II	**Process management**	**(08 hrs)**	**COs Mapped - CO2**

Process: Concept, Process control block, Process state diagram, Inter process communication
Process scheduling: Types, First come first serve, Shortest job first, Round robin, Priority based scheduling
Threads: Multi core programming, Multithreading models, Implicit threading, Threading issues

Unit III	**Process coordination**	**(07 hrs)**	**COs Mapped - CO3**

Synchronization: The critical-section problem, Peterson's solution, Synchronization hardware, Mutex locks, Semaphores, Monitors

Classic problems of synchronization: Producer-consumer problem, Reader/writer problem, Dining philosopher problem

Deadlock: Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance and detection, Recovery from deadlock.

Unit IV	Memory Management	(07 hrs)	COs Mapped - CO4

Memory Partitioning: Fixed partitioning, Dynamic partitioning

Contiguous Memory allocation techniques: First fit, Best fit, Worst fit, Swapping, Structure of the page table, Segmentation, Demand paging

Page Replacement algorithms: First in first out, Optimal page replacement, Least recently used translation look aside buffer

Unit V	I/O management and Introduction to Linux	07 hrs	COs Mapped – CO4, CO5

I/O devices, Disk scheduling algorithms: First come first serve, Shortest seek time first algorithm, SCAN, Circular-SCAN

Introduction to Linux: Essential features, File systems and directories, Linux shell commands such as pwd, cd, ls, cat, rm, cp, mkdir and Linux utilities such as tr, sed, grep, egrep, awk. File access rights.

Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", WILEY, ISBN:978-81-265-5427-0, 9th Edition
2. William Stallings, "Operating System: Internals and Design Principles", Prentice Hall, ISBN 10: 0-13-380591-3, ISBN 13: 978-0-13-380591-8, 8th Edition

Reference Books

1. Tom Adelstein and Bill Lubanovic, "Linux System Administration", O'Reilly Media, ISBN 10: 0596009526, ISBN 13: 978-0596009526
2. Harvey M. Deitel, "Operating Systems", Prentice Hall, ISBN 10: 0131828274, ISBN 13: 978-0131828278

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit-2, Unit-4, Unit 5 (Quiz 15 marks each and will be converted to 15 Marks)	15
2	Theory assignment on Unit-3 (One Assignment on Unit III of 10 marks will be converted to 5 Marks)	05
	Total	**20**

S. Y. B. Tech. Artificial Intelligence and Data Science		
Pattern 2022 Semester: IV		
ADS222014: Database Management System		

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: ADS222001: Fundamentals of Data Structure

Companion Course: ADS222019: Database Management System Laboratory

Course Objectives:

● To understand the fundamentals of database management System and database query languages

● To know the principles of database design and transaction management

● To study database system architecture and NOSQL databases

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Illustrate applications of databases, and features of RDBMS	2-Understand
CO2	Construct database queries using SQL, PL/ SQL and Mongo DB.	3-Apply
CO3	Demonstrate ability to prepare logical design of database using ER model and normalization technique.	2-Understand
CO4	Compare RDBMS and NOSQL databases	2-Understand
CO5	Explain various protocols for Transaction Management	2-Understand

COURSE CONTENTS			
Unit I	**Relational Model and SQL**	**(08 hrs)**	**COs Mapped - CO1,CO2**

Introduction: Basic concepts, Advantage of DBMS over file processing system, Data Abstraction, Database Language, Structure of DBMS, Data Modeling, database applications.
RDBMS: Basic concepts, Attributes and Domain, Integrity Constraints.
SQL: Introduction to Relational Algebra and Tuple Relational Calculus, Introduction to SQL, SQL Data types and Literals, DDL, DML, DCL, TCL, SQL Select Query and Clauses.

 Topic for Self-Study : Codd's Rule

Unit II	**Advanced SQL and PLSQL**	**(08 hrs)**	**COs Mapped - CO2**

SQL Advanced Features: Set Operation, Aggregate Function, Null Values, Nested Sub Query, View, Joins, Sequence, Index, Introduction to Embedded and Dynamic SQL.
 Introduction to PL/SQL: Data types, Procedures, Functions, Cursor, Trigger, Package, Assertions, Roles and Privileges.

 Topic for Self-Study : Oracle Database Architecture

Unit III	Database Design: Entity- Relationship Model and Relational Database Design	(06 hrs)	COs Mapped - CO3

Database Design and ER Model: ER Model, Extended E-R Features, converting ER model and EER model to tables, schema diagrams.
Relational Database Design: Functional Dependency, Normalization 1NF, 2NF and 3NF

Topic for Self-Study : BCNF.

Unit IV	NO SQL Database	(07 hrs)	COs Mapped - CO2, CO4

Database-system Architecture: Centralized and Client-Server Architecture, Server System Architecture, Introduction to Parallel and Distributed databases.
NoSQL Databases: Structured, Unstructured Data and Semi-Structured Data, Comparison of RDBMS and NoSQL, CAP theorem and BASE property.
Types of NoSQL Databases: Key-value store, document store, graph, wide column stores.
Mongo DB: Data types, CRUD operations, Aggregation, Indexing, Sharding.

Unit V	Transaction Management	(07 hrs)	COs Mapped - CO5

Transaction: Transaction concept, Transaction state, Transaction Property, Concurrent Executions
Serializability: Conflict serializability, View Serializability, Testing for Serializability, Deadlock prevention, Deadlock Detection and Recovery from deadlock.
Concurrency Control Protocols: Two phase Locking, Timestamp-based protocol.
Recovery: Failure classification, Shadow-Paging and Log-Based Recovery.

Text Books
1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", 6th Edition Tata McGraw Hill Publishers, ISBN 0-07-120413-X.
2. Kristina Chodorow, "MongoDB: The Definitive Guide", 3rd Edition, Oreilly Publications, ISBN 1491954469

Reference Books
1. C J Date, "An Introduction to Database Systems" ,Addison-Wesly, ISBN:0201144719
2. Pramod J. Sadalage, Martin Fowler, "NoSQL Distilled", Addisen Wesley publication, ISBN:0201144719

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit 2, Unit 3, Unit 4 (Quiz 15 marks each and will be converted to 15 Marks)	15
2	Theory assignment on Unit-5 (One Assignment on Unit 5 of 10 marks will be converted to 5 Marks)	5
	Total	**20**

S. Y. B. Tech. Artificial Intelligence and Data Science Pattern 2022 Semester: IV ADS22015: Software Engineering and Project Management		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**Continuous Comprehensive Evaluation:** 20 Marks **InSem Exam:** 20 Marks **EndSem Exam:** 60 Marks

Prerequisite Courses:-ADS222001:Fundamentals of Data Structures, ADS222005:Programming Paradigms and Java Programming

Course Objectives:
- To understand the need for the software life cycle and its implications
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements
- To understand project management through the life cycle of the project and current practices in the IT industry

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Identify appropriate process model for software development.	3-Apply
CO2	Model software requirements for software development.	3-Apply
CO3	Make use of emerging trends for software project management.	3-Apply
CO4	Utilize project metrics for software project estimation and process improvement	3-Apply
CO5	Analyze software risks involved in project development.	4-Analyze

COURSE CONTENTS				

Unit I	**Introduction to Software Engineering and Software Process Models**	**(08hrs)**	**CO1**

Software Engineering: The Nature of Software, Defining Software, Software Engineering Process, Software Engineering Practice.

Process Models: A Generic Process Model, Process Assessment and Improvement, Prescriptive process models.

Agile Development: Agility, Agility and Cost of change, Agile process, Extreme Programming (XP), Other Agile Process Models- Scrum, Feature Driven Development (FDD)

Self-Study Topic: Use of Agile to enhance business processes by major players such as Sky, Philips and JP Morgan Chase

Unit II	**Understanding Requirements and Design Concepts**	**(07hrs)**	**CO2**

Requirement Engineering: Establishing the Groundwork, Eliciting Requirements, Developing the use cases, Building the Requirement model, Negotiate Requirements, Validating Requirements, and Requirement Analysis.

Design Concepts: Design within the context of Software Engineering, The Design Process, Design Concepts, and The Design Model.

Self-Study Topic: Software Requirement Specification of Library Management System

Unit III	**Emerging Trends in Software Engineering & Project Management Concepts**	**(07hrs)**	**CO3**

Emerging Trends: Technology evolution, Observing Software Engineering Trends, Identifying soft trends, Technology directions, Tools related trends.

Project Management Concepts: The management spectrum, People, The Product, The Process, The Project, The W^{5}HH Principle

Unit IV	Project Estimation and Software Process Improvement	(07hrs)	CO4

Project Metrics: Software Measurement, Metrics for Software Quality, Metrics for Small Organizations

Estimation for Software Projects: Observation on Estimation, The Project Planning Process, Software Scope and Feasibility, Resources, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, Specialized Estimation Techniques

Software Process Improvement: Introduction, Approaches to SPI, Maturity Models - Capability Maturity Model (CMM), Capability Maturity Model Integration (CMMI)

Unit V	Project Scheduling and Risk Management	(07hrs)	CO5

Project Scheduling: Basic Principles, Task set for Software Project, Task Network, Scheduling

Risk Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, The RMMM Plan

Self-Study Topic: Risk management for E-commerce website

Text Books
1. Roger Pressman, "Software Engineering: A Practitioner's Approach"‖, McGraw Hill, ISBN 0-07-3375
2. Ian Sommerville,"Software Engineering", Addison and Wesely, ISBN 0-13-703515-2.

Reference Books
1. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India, ISBN-13: 978-8120348981
2. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715.

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit-1, Unit-2, Unit-4 and Unit-5 (Quiz 15marks each and will be converted to 15 marks)	15
2	Theory assignment on Unit-3 (One assignment on Unit-3 of 10 marks will be converted to 5 marks)	05
	Total	**20**

S. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: IV** **ADS222016:Design Thinking**			
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**	
Theory :01hr/week	-	-	

Prerequisite Courses : FYE 221015 Engineering Exploration

Companion Course:- ADS222020: Project Based Learning -Design Thinking

Course Objectives:
- To understand concepts of design thinking
- To understand the different phases of design thinking

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain stages and process of design thinking	2- Understand
CO2	Identify the methods to empathize and define the problem	2-Understand
CO3	Apply the ideation techniques for problem solving	3-Apply
CO4	Construct the prototype to evaluate a design	3-Apply
CO5	Apply testing techniques to improve the performance.	3- Apply
COURSE CONTENTS		

Unit I	**Overview of Design Thinking Process**	**(02 hrs)**	**CO1**

Introduction to DesignThinking - Definition, Ideas, Inventions, Innovations, Origin of DesignThinking, Importance of DesignThinking, Problem solving, DesignThinking tools.
Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test.

MOOC course: NPTEL :
Design Thinking - A Primer: Prof. BalaRamadurai
Week 1:https://drive.google.com/drive/folders/19wC_ynKlyLYdnPRV_aNrxIsUBvt9UcNo?usp=share_link

Unit II	**Empathy and Define**	**(02 hrs)**	**COs Mapped - CO2**

Empathy - How to emphasize, Role of empathy in DesignThinking, Purpose of empathy maps, Things to be done prior to empathy mapping, Customer journey mapping.
Define -How might we questions, The Five Whys Method.

MOOC course: NPTEL :
Design Thinking - A Primer: Prof. BalaRamadurai
Week 2:https://drive.google.com/drive/folders/1UT_eELRZJ4g0CtYNkjJh4klcEBvpFvsi?usp=share_link

Unit III	**Ideation**	**(02hrs)**	**COs Mapped – CO3**

Idea generation- Basic design directions, Themes of Thinking, Inspiration and references, Brainstorming, Value,Inclusion, Sketching, Presenting ideas, Refinement, Thinking in images, Thinking in signs, Appropriation, Humour,Personification, Visual metaphors.

MOOC course: NPTEL :
Design Thinking - A Primer: Prof. BalaRamadurai
Week 3:https://drive.google.com/drive/folders/1EPW5wZJtGd0P8y3-ixkHMbvnM_VUq3wC?usp=share_link

Unit IV	Prototype		(02hrs)	COs Mapped – CO4
Prototyping- Assumptions during the DesignThinking process, Storyboards, Models and prototypes, Quick and Dirty Prototyping, Validation in the market, Best practices of presentation.				
MOOC course: NPTEL : **Design Thinking - A Primer:** Prof. BalaRamadurai **Week 4:**https://drive.google.com/drive/folders/111xxzuCbCZ75Ut7jm5wVEAzotQprX_et?usp=share_link				
Unit V	Testing and Implementation		(02 hrs)	COs Mapped – CO5
Test Phase –Technique for interviews and surveys, Kano Model, Desirability testing, Testing prototypes, Obtaining feedback to refine product usability. **Implementation** - Efficiency and effectiveness of innovation and implementation strategies.				
MOOC course: NPTEL : **Design Thinking - A Primer:** Prof. BalaRamadurai **Week 4:**https://drive.google.com/drive/folders/111xxzuCbCZ75Ut7jm5wVEAzotQprX_et?usp=share_link				
Text Books				
1. "DesignThinking", Gavin Ambrose, Paul Harris, AVA Publishing (UK) Ltd, ISBN:978-2-940411-17-7. 2. "Handbook of DesignThinking - Tips & Tools for how to DesignThinking", Christian Mueller-Rotenberg. 3. "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Tim Brown., HarperCollins Publication, ISBN:9780061937743.				
Reference Books				
1. "DesignThinking for Strategic Innovation: What They Can't Teach You at Business or Design School", IdrisMootee, Wiley, ISBN: 978-1-118-62012-0 2. "Designing for Growth: ADesignThinkingToolKit for Managers", Jeanne Liedtka and Tim Ogilvie, Columbia University Press, ISBN: 0231158386, 9780231158381				
MOOC Course				
1.Design Thinking - A Primer: Prof. BalaRamadurai- https://archive.nptel.ac.in/courses/110/106/110106124				

S. Y. B. Tech. Artificial Intelligence and Data Science Pattern 2022 Semester: IV ADS222017: Advanced Data Structures Lab		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 04 hrs/week	**02**	**Term Work: 25 Marks** **Practical Exam: 50 Marks**
Prerequisite Courses:- ADS222001:Fundamentals of Data structures, ADS222003:Discrete Mathematics		
Companion Course: ADS222012: Advanced Data Structures		
Course Objectives: • To understand basic concepts of non linear data structures such as trees, graphs • To study the concepts of hash table and files • To learn advanced data structures such as indexing techniques and multiway search trees		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level**
CO1	Make use of non-linear data structures such as graph and trees to solve a given problem	3-Apply
CO2	Use different representations of symbol table	3-Apply
CO3	Apply the hash table and it's collision resolution methods and different file handling techniques	3-Apply
CO4	Use efficient indexing techniques and multiway search trees to store and maintain data	3-Apply
CO5	Analyze an algorithm used for solving a given problem	4-Analyze

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	**Flight management**: There are flight paths between cities. If there is a flight between city A and city B then there is an edge between the cities. The cost of the edge can be the time that flight takes to reach city B from A, or the amount of fuel used for the journey. Write a menu driven C++ program to represent this as a graph using adjacency matrix and adjacency list. The node can be represented by the airport name or name of the city. Check whether cities are connected through flight or not. Compare the storage representation.	CO1, CO5
2	**Graph traversal**: The area around the college and the prominent landmarks of it are represented using graphs. Write a menu driven C++ program to represent this as a graph using adjacency matrix /list and perform DFS and BFS.	CO1, CO5

3	**Activity on vertex(AOV) network**: Sandy is a well organized person. Every day he makes a list of things which need to be done and enumerates them from 1 to n. However, some things need to be done before others. Write a C++ code to find out whether Sandy can solve all his duties and if so, print the correct order	CO1, CO5
4	**Binary search tree:** Write a menu driven C++ program to construct a binary search tree by inserting the values in the order give, considering at the beginning with an empty binary search tree, After constructing a binary tree- i. Insert new node, ii. Find number of nodes in longest path from root, iii. Minimum data value found in the tree iv. Search a value v. Print values in ascending and descending order	CO1, CO5
5	**Expression tree**: Write a menu driven C++ program to construct an expression tree from the given prefix expression eg. +--a*bc/def and perform following operations: 1. Traverse it using post order traversal (non recursive) 2. Delete the entire tree 3. Change a tree so that the roles of the left and right pointers are swapped at every node	CO1, CO5
6	**A Dictionary using BST**: A Dictionary stores key and value pairs Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique. Standard Operations: Insert(key, value), Find(key), Delete(key) Write a menu driven C++ program to provide above standard operations on dictionaries and provide a facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Binary Search Tree for implementation	CO1, CO5
7	**Tree using traversal sequence**: Write a C++ program to construct the binary tree with a given preorder and inorder sequence and Test your tree with all traversals	CO1, CO5
8	**A Dictionary using AVL**: A Dictionary stores key and value pairs Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique. Standard Operations: Insert(key, value), Find(key), Delete(key) Write a menu driven C++ program to provide above standard operations on dictionaries and provide a facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Height balanced tree(AVL) and find the complexity for finding a keyword	CO2, CO5
9	**Telephone book management**: Consider the telephone book database of N clients. Write a menu driven C++ program to make use of a hash table implementation to quickly look up a client's telephone number. Use of two collision handling techniques and compare them using number of comparisons required to find a set of telephone numbers	CO3, CO5

10	**A Dictionary using Hash table**: A Dictionary stores key and value pairs Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique. Standard Operations: Insert(key, value), Find(key), Delete(key) Write a menu driven C++ program to provide above standard operations on dictionaries Write a menu driven C++ program to provide all the functions of a dictionary (ADT) using hashing and handle collisions using chaining.	CO3, CO5
11	**Sequential File:** The students' club members (MemberID, name, phone, email) list is to be maintained. The common operations performed include these: add member, search member, delete member, and update the information. Write a menu driven C++ program that uses file operation to implement the same and perform all operations.	CO3, CO5
12	**Min/max Heaps**: Marks obtained by students of second year in an online examination of a particular subject are stored by the teacher. Teacher wants to find the minimum and maximum marks of the subject. Write a menu driven C++ program to find out maximum and minimum marks obtained in that subject using heap data structure. Analyze the algorithm	CO4, CO5
13	**A Dictionary using STL map and Hashmap**: Implement Dictionary (key and value pairs) using using **STL map in C++** and **Hashmap in Java** and compare all dictionary implementation 1. BST 2. AVL 3. User defined Hash table 4. STL Map 5. Hashmap in Java Use Visual C++ and Java Compiler	CO1, CO2, CO3, CO5
14	Study Assignment: 1. Explain Data structures used in whatsapp in details 2. Consider following real time application and explain in detail the combinations of data structures and algorithms used in it. Social media applications require efficient and scalable data structures to manage user-generated content, facilitate user interactions, and ensure the reliability and availability of the platform. The primary challenge in designing data structures for social media applications is to accommodate the massive volume of data generated by users, while providing fast and responsive access to that data. Some specific challenges that data structures in social media applications must address include: • Handling user interactions such as likes, comments, and shares, and ensuring the integrity and consistency of those interactions. • Supporting fast and flexible search and filtering of content based on user preferences, geographic location, hashtags, and other criteria. • Managing relationships between users, such as friends, followers, and groups, and providing fast and efficient access to that information.	CO1 to CO5

Mini Project	
Student has to perform one mini project based on concepts covered in the course, Write a detailed problem statement for your project, Design and implement a code for the same using appropriate data Structures.	CO1 to CO5

Additional Programming Problems		
1	**Skip Lists:** Write a C++ program to create a skip list for a given set of elements. Find the element in the set that is closest to some given value. (note: Decide the level of element in the list Randomly with some upper limit)	CO3, CO5
2	**Huffman algorithm**: Write a C++ program to implement a file compression algorithm that uses a binary tree. Your program should allow the user to compress and decompress messages containing alphabets using the standard Huffman algorithm for encoding and decoding.	CO1, CO5
3	**Tour management**: Tour operators organize guided bus trips across Maharashtra. Tourists may have different preferences. Tour operators offer a choice from many different routes. Every day the bus moves from starting city S to another city F as chosen by the client. On this way, the tourists can see the sights alongside the route traveled from S to F. Clients may have preference to choose the route. There is a restriction on the routes that the tourists may choose from, the bus has to take a short route from S to F or a route having one distance unit longer than the minimum distance. Two routes from S to F are considered different if there is at least one road from a city A to a city B which is part of one route, but not of the other route. Write a C++ program to solve above problem.	CO1, CO5
4	**Optimal Binary search tree**: Given sequence k = k1 <k2 < ... <kn of n sorted keys, with a search probability pi for each key ki . Write a C++ program to build the Binary search tree that has the least search cost given the access probability for each key.	CO2, CO5
5	**Trie** : Write a C++ program to store a collection of strings that have to be inserted in the trie and perform search operation	CO4, CO5
Guidelines for Laboratory Conduction		
Use of coding standards and Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. Operating System recommended:- Linux or its derivative Programming tools recommended: - Open Source line gcc/g++ (Visual C++ compiler for few assignments and note the difference)		
Guidelines for Student's Lab Journal		
The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form.		
Guidelines for Termwork Assessment		

Continuous assessment of laboratory work shall be based on the overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include
R1- timely completion (10),
R2- understanding of assignment (10) and
R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)
Mini Project assessment will be based on Teamwork, Communication skill, Social relevance of mini project, Ethics followed.

S. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: IV
ADS222018: Operating Systems Laboratory

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02 hrs/week	**01**	**Term Work: 25 Marks** **Practical Exam : 25 Marks**

Prerequisite Courses:- ADS222001:**Fundamentals of Data Structures**

Companion Course:- ADS222013: Operating Systems

Course Objectives:
- To understand operating system services, types of operating systems and shell scripts
- To study process scheduling algorithms and multithreading techniques
- To get acquainted with the concepts of synchronization, deadlock prevention and avoidance algorithms
- To learn concepts of memory management and I/O management techniques
- To introduce Linux operating systems

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Explain operating system services, types of operating systems and basic shell commands	2- Understand
CO2	Illustrate the concept of process scheduling algorithms to solve scheduling problems	2- Understand
CO3	Compare algorithms for deadlock detection, prevention and avoidance	2- Understand
CO4	Use algorithms for page replacement and I/O management	3- Apply
CO5	Describe Linux commands and utilities such as grep, tr, sed, awk	2- Understand

Sr. No.	List of Laboratory Assignments/ Experiments	COs Mapped
1	Write a shell script for implementation of control flow statements.	**CO1**
2	Write a shell script to find factorial of a given number.	**CO1**
3	Write a C program to compute and print the average waiting time, average turnaround time and CPU burst times for the given list of processes. Display/print the Gantt chart for first come first serve, shortest job first, priority scheduling and round robin scheduling algorithm.	**CO2**
4	Write a C program to implement inter process communication using shared memory, pipes, named pipes and signals	**CO2**
5	Write a C program to implement producer-consumer problem	**CO3**
6	Write a C program to implement page replacement algorithms such as first in first out, least recently used and optimal page replacement	**CO4**
7	Installation of Linux operating system and basic configuration.	**CO5**
8	Assignment on Unix basic commands such as pwd, ls, cat, redirection and pipes and Unix utilities like tr, sed, grep, egrep, awk.	**CO5**

9	Execute following AWK operations on the text file : 1 Print the lines which match the given pattern. 2 Splitting a Line Into Fields 3 To find the length of the longest line present in the file 4 Printing the lines with more than specified characters	**CO5**

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.

Use of open source software is to be encouraged. Operating System recommended: Linux or its derivative. Programming tools recommended: Open Source line gcc/g++

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form.

Guidelines for Term work Assessment

Continuous assessment of laboratory work shall be based on overall performance of a student.

Assessment of each laboratory assignment shall be based on rubrics that include

R1- timely completion (10),

R2- understanding of assignment (10) and

R3- presentation/clarity of journal writing (10).

S. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: IV** **ADS222019: Database Management System Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical :02 hrs/week	**01**	**Term Work: 25 Marks** **Practical : 25 Marks**

Prerequisite Courses: ADS222001: Fundamentals of Data Structure

Companion Course: ADS222014: Database Management System

Course Objectives:

● To understand the fundamentals of database management System and database query languages

● To know the principles of database design and transaction management

● To study database system architecture and NOSQL databases

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Illustrate applications of databases, and features of RDBMS	2-Understand
CO2	Construct database queries using SQL, PL/ SQL and Mongo DB.	3-Apply
CO3	Demonstrate ability to prepare logical design of database using ER model and normalization technique.	2-Understand
CO4	Compare RDBMS and NOSQL databases	2-Understand
CO5	Explain various protocols for Transaction Management	2-Understand

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	**Consider the given Database Schema:** **employee (employee-name, street, city)** **works (employee-name, company-name, salary)** **company (company-name, city)** **manages (employee-name, manager-name)** **Write SQL queries for the following** 1. Find the names of all employees who work for First Bank Corporation. 2. Find the names and cities of residence of all employees who work for First Bank Corporation 3. Find the names, street addresses, and cities of residence of all employees who work for First Bank Corporation and earn more than Rs.10,000. 4. Find all employees in the database who live in the same cities as the companies for which they work. 5. Find all employees in the database who live in the same cities and on the	**CO1, CO2**

	same streets as do their managers. 6. Find all employees in the database who do not work for First Bank Corporation. 7. Find all employees in the database who earn more than each employee of Small Bank Corporation. 8. Assume that the companies may be located in several cities. Find all companies located in every city in which Small Bank Corporation is located. 9. Find all employees who earn more than the average salary of all employees of their company. 10. Find the company that has the most employees. 11. Find the company that has the smallest payroll. 12. Find those companies whose employees earn a higher salary, on average, than the average salary at First Bank Corporation.	
2	**Consider the given relational table:** **employee(empno , empname, designation, city, salary, zipcode, county)** Write SQL queries for the following 1. Create a sequence used to generate employee numbers for the empno column of the emp table. 2. Create an Index on county. 3. Find the country whose zipcode = 071 and check whether the query uses the Index and write your observation. 4. Create a view for employees having salary < 50000 and stays in 'Mumbai'	**CO1, CO2**
3	Consider the given database schema: **Student (studentid , studentname,instructorid,studentcity)** **Instructor(instructorid,Instructorname,instructorcity,specialization)** **Use all types of Joins** 1. Find the instructor of each student. 2. Find the student who is not having any instructor. 3. Find the student who is not having any instructor as well as instructor who is not having student. 4. Find the students whose instructor's specialization is computer. Create a view containing total number of students whose instructor belongs to "Pune**".**	**CO1, CO2**
4	Draw an ER diagram for university database system using ER and EER features and normalize the table till 3NF. Create the database in MYSQL and Write a menu driven program in Java to connect with a database using Jdbc-Odbc Connectivity and to store and retrieve information	**CO3**

5	Create a database with following schemas
	Borrower(Rollin, Name, DateofIssue, NameofBook, Status) &
	Fine(Roll_no,Date,Amt)
	1. Write a PL/SQL block to accept input for Borrower table.
	2. Write a PL/SQL block using control structures to calculate fine by using the following rules:
	        a. check the number of days (from date of issue), if days are between 15 to 30 then fine
	            amount will be Rs 5per day
	        b. If no. of days>30, per day fine will be Rs 50 per day
		CO1, CO2

	c. for days less than 30, Rs. 5 per day. After submitting the book, status will change from I to R. If condition of fine is true, then details will be stored into fine table.	
6	Create two tables O_Roll(Rollno,Name,DOB,Phone,address) N_Roll(Rollno,Name,DOB,Phone,address) Write a PLSQL block using various types of cursor(implicit,Explicit,For, Parameterized) to merge records from O_Roll table with that of N_Roll in such a way duplicate records are to be eliminated.	**CO1, CO2**

7	Create a Library database with the schema
	Books(AccNo,Title,Author,Publisher,Count).
	
	     a. Create a table Library_Audit with same fiels as of Books.
	     b. Create a before trigger to insert records into Librry_Audit table if there is deletion in Books table.
	
	Create a after trigger to insert records into Librry_Audit table if there is updation in Books table.
		CO1, CO2

8	Implement the following MongoDb Query
	   1. Create a collection named books.
	   2. Insert 5 records with field TITLE,DESCRIPTION,BY,URL,TAGS AND LIKES
	   3. Insert 1 more document in collection with additional field of user name and comments.
	   4. Display all the documents whose title is 'mongodb'.
	   5. Display all the documents written by 'john' or whose title is 'mongodb'.
	   6. Display all the documents whose title is 'mongodb' and written by 'john'.
	   7. Display all the documents whose like is greater than 10.
	   8. Display all the documents whose like is greater than 100 and whose title is either 'mongodb' or written by 'john'.
	   9. Update the title of 'mongodb' document to 'mongodb overview'
	   10. Delete the document titled 'nosql overview'.
	   11. Display exactly two documents written by 'john'.
	   12. Display the second document published by 'john'.
	   13. Display all the books in the sorted fashion.
	Insert a document using save method.
		CO2

9	Create the collection Books having the following fields TITLE, DESCRIPTION, BY, URL, TAGS AND LIKES.
	   Implement the following Aggregation and Indexing Queries
	   1. Find the number of books published by john.
	   2. Find books which have minimum likes and maximum likes published by john.
	   3. Find the average number of likes of the books published by john.
	   4. Find the first and last book published by john..
	   5. Create an index on author name.
	Display the books published by john and check if it uses the index which we have created
		CO2

10	**Create the following collection in mongodb**
	    Student (rollno,name,address,contact_no,department)
	    Write a menu driven program in python to connect with the database and to perform the following operation
	    1. Insert details of the student.
	    2. Update the address of Pooja from Shivaji Nagar to Saraswati Nagar.
	    3. Display the student's information.
	    4. Delete a student's record whose rollno is 32.
		CO2

Guidelines for Laboratory Conduction
Use of open source software is encouraged Operating System recommended: -64-bit Open-source Linux or its derivative Programming tools recommended:- Front End: Java/ Python any other language Backend : MongoDB/ MySQL
Guidelines for Student's Lab Journal
The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Theory-Concept in brief, conclusion/analysis). Program codes with sample output of all performed assignments are to be submitted as softcopy.
Guidelines for Term work Assessment
Continuous assessment of laboratory work shall be based on overall performance of students.Assessment of each laboratory assignment shall be based on rubrics that include Rubric R1- timely completion(10 mark) , R2- understanding of assignment (10 mark), R3-presentation/clarity of journal writing (10 mark)

S. Y. B. Tech. Artificial Intelligence and Data Science Pattern 2022 Semester: IV ADS222020: Project Based Learning - DesignThinking Lab		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Term Work : 25 Marks**
Prerequisite Courses: FYE 221015 Engineering Exploration		
Course Objectives: • To understand concepts of design thinking • To understand the different phases of design thinking		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level**
CO1	Explain stages and process of design thinking	2- Understand
CO2	Identify the methods to empathize and define the problem	2- Understand
CO3	Apply the ideation techniques for problem solving	3- Apply
CO4	Construct the prototype to evaluate a design	3- Apply
CO5	Apply testing techniques to improve the performance.	3- Apply

List of Tasks		
Sr. No.	**Tasks to be performed**	**COs Mapped**
1	Creating teams, assigning roles and responsibilities	CO1
2	Empathy : Brain storming, ideation and setting actionable goal statements	CO1, CO2
3	Identify stakeholders, people/organization, problems and opportunities, prepare questionnaire and discuss with stakeholders	CO1, CO2
4	Draw mind maps	CO1, CO2
5	Construct empathy map	CO2
6	Develop customer journey map	CO1, CO3
7	Identify required skills and techniques to solve listed problems	CO1, CO2, CO3
8	Enlist all possible solutions	CO1, CO2,CO3
9	Make a prototype for user testing	CO4
10	Test the prototype	CO5

Guidelines for Laboratory Conduction
●   Students will work in a group, preferably 4-6 students per group.   ●   Entire project work is divided into 10 tasks.   ●   Faculty is to monitor progress of each task during phases of project work.
Guidelines for students Lab Journal
Students will submit the term work in the form of project report at the end of semester.
Guidelines for Term work Assessment

Each task carries 30 marks based on following rubrics.

R1: Timely completion	10 Marks
R2: Understanding	10 Marks
R3: Documentation	10 Marks

Final presentation: 30 Marks
Final project report : 30 Marks