K.K.Wagh Institute of Engineering Education and Research, Nashik (Autonomous w.e.f. A.Y.2022-23)
Details of Course Structure: TY B.Tech (2023 Pattern) Semester: V

Board of Studies in Computer Engineering

Course Code	Course Type	Title of Course	Teaching Scheme Hrs./week			Evaluation Scheme and Marks								Credits			
			TH	TU	PR	In Sem	End Sem	CCE	TU	TW	PR	OR	Total	TH	TU	PR	Total
2301301	PCC	Data Structures and algorithms	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
2311302	PCC	Artificial Intelligence	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
2301303	PCC	Database Management Systems	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
2301304	PCC	Database Management Systems Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
2301305	PCC	Data Structures and algorithms Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
	PEC	Program Elective Course I	3	-	-	20	60	20	-	-		-	100	3	-	-	3
	PEC	Program Elective Course I Lab	-	-	2	-	-	-	-	25	-	25	50	-	-	1	1
2301308	OE	Management Information System	2	-	-	-	-	50	-	-	-	-	50	2	-	-	2
2301309	MDM	Computer Organization and Architecture	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
2301310	CEP	Project Based Learning	-	1	2	-	-	-	25	25	-	-	50	-	1	1	2
		Total	**17**	**1**	**8**	**100**	**300**	**150**	**25**	**100**	**50**	**25**	**750**	**17**	**1**	**4**	**22**

Elective I		**Elective I Lab**	
Course Code	**Title of Course**	**Course Code**	**Title of Course**
2301306A	Internet of Things	2301307A	Internet of Things Lab
2301306B	Augmented Reality and Virtual Reality	2301307B	Augmented Reality and Virtual Reality Lab
2301306C	Software Testing and Quality Assurance	2301307C	Software Testing and Quality Assurance Lab

Name and Sign of BoS Chairman **Sign of Director**

Board of Studies in Computer Engineering

Course Code	Course Type	Title of Course	Teaching Scheme Hrs./week			Evaluation Scheme and Marks								Credits			
			TH	TU	PR	In Sem	End Sem	CCE	TU	TW	PR	OR	Total	TH	TU	PR	Total
2301311	PCC	Data Science and Big data	3	-	-	20	60	20	-	-		-	100	3	-	-	3
2301312	PCC	Theory of Computation	3	-	-	20	60	20	-	-		-	100	3	-	-	3
2301313	PCC	Data Science and Big data Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
	PEC	Program Elective CourseII	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
	PEC	Program Elective CourseIII	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
2301316	PEC	Programming Lab	-	-	2	-	-	-	-	25	-	25	50	-	-	1	1
2301317	MDM	Microcontrollers and Embedded Systems	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
2301318	OE	Project Planning and Management	2	-	-	-	-	50	-	-	-	-	50	2	-	-	2
2301319	VSEC	Full Stack	-	1	2	-	-	-	-	25	-	25	50	-	1	1	2
2301320	RM	Research Seminar	-	-	2	-	-	-	-	50	-	-	50	-	-	1	1
		Total	**17**	**1**	**8**	**100**	**300**	**150**	**-**	**125**	**25**	**50**	**750**	**17**	**1**	**4**	**22**

Elective II		Elective III	
Course Code	Title of Course	Course Code	Title of Course
2301314A	User Interface and User Experience	2301315A	Cloud computing
2301314B	Generative AI and Prompt Engineering	2301315B	Natural Language Processing
2301314C	High Performance Databases	2301315C	High Performance Computing

Name and Sign of BoS Chairman **Sign of Director**

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: V
2301301: Data Structures and Algorithms

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: - 2301212: Data structures, 2301201: Discrete Structure

Course Objectives:

- To understand basic concepts of nonlinear data structures such as trees, graphs
- To learn advanced data structures such as indexing techniques and multiway search trees
- To analyze performance of different algorithmic strategies in terms of time and space

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

	Course Outcomes	**Bloom's Level**
CO1	Describe the asymptotic notations in algorithm analysis	2 - Understand
CO2	Make use of trees and graph data structures to effectively solve a given problem	3-Apply
CO3	Use different representations of symbol table , efficient indexing techniques and multiway search trees to store and maintain data	3-Apply
CO4	Apply Greedy and Dynamic Programming strategies to solve optimization and scheduling problems.	3-Apply
CO5	Apply Backtracking and Branch-and-Bound techniques to solve constraint satisfaction and combinatorial optimization problems.	3-Apply

COURSE CONTENTS

Unit I	**Algorithm Analysis and Graph Algorithms**	**(07 hrs)**	**CO1, CO2**

Analysis: Input size, best case, worst case, average case Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, O, Ω, Θ, o and ω notations, polynomial and non-polynomial problems. Introduction to deterministic and non-deterministic algorithms, P- class problems, NP-class of problems, Polynomial problem reduction NP complete problems

Graphs- 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

Unit II	**Trees**	**(07 hrs)**	**CO2**

Trees- Basic terminology, General tree and its representation, Representation using sequential and linked organization, converting 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, Operations on binary tree, Applications of Binary trees

Binary Search Tree (BST) - Concept, Definition, Comparison with binary tree, BST operations, applications of BST

Threaded binary tree, Expression tree

Unit III	**Symbol table, indexing and multiway tree**	**(08 hrs)**	**CO3**

Symbol Tables: Static and dynamic tree tables, AVL trees, AVL Tree implementation, Algorithms and analysis of AVL Tree

Multiway search trees, B-Tree- Insertion, Deletion, B+ Tree - Insertion, Deletion, Use of B+ tree in Indexing

Heaps- Concept, Insert, Delete operation, Heap sort

Unit IV	Greedy And Dynamic Programming algorithmic Strategy	(07 hrs)	CO4

Introduction to Algorithmic Strategies: Greedy, Dynamic Programming, Backtracking, Branch and Bound

Greedy strategy: Principle, control abstraction, time analysis of control abstraction, knapsack problem, scheduling algorithms -Job scheduling and activity selection problem.

Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomial coefficients, OBST, 0/1 knapsack, Chain Matrix multiplication.

Unit V	Backtracking and Branch and Bound	(07 hrs)	CO5

Backtracking: Principle, control abstraction, time analysis of control abstraction, 8-queen problem, graph coloring problem, sum of subsets problem.

Branch and Bound: Principle, control abstraction, time analysis of control abstraction, strategies FIFO, LIFO and LC approaches, TSP, knapsack problem.

Text Books

1. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786
2.Gills Brassard and Paul Bartly, Fundamentals of Algorithmic, PHI New Delhi.
3.The Design and Analysis of Computer Algorithms, Aho,Hopcroft,Ullman

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:978007066726
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms" , ISBN 978-0-262-04630-5

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Quiz (10 marks will be converted to 4 marks)	4
4	Unit IV - Assignment (10 marks and will be converted to 4 marks)	4
5	Unit V - Assignment (10 marks and will be converted to 4 marks)	4
	Total	**20**

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T. Y. B. Tech Computer Engineering
Pattern 2023 Semester: V
2311302: Artificial Intelligence

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: - 2301212 : Data Structures

Course Objectives:

- To study the concept of Artificial Intelligence
- To illustrate problem solving using search strategies for AI
- To learn adversarial search methods for AI
- To get acquainted with the fundamentals of logical reasoning related to AI
- To get familiar with the fundamentals of knowledge representation in AI

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

	Course Outcomes	Bloom's Level
CO1	Identify Intelligent agents for various AI applications	3-Apply
CO2	Illustrate different informed search / uninformed search or heuristic approaches for AI	2-Understand
CO3	Identify adversarial search methods for AI	3-Apply
CO4	Relate reasoning for making AI enabled systems	2-Understand
CO5	Make use of knowledge representation for AI systems	2-Understand

COURSE CONTENTS

Unit I	Introduction of Artificial Intelligence	(06 hrs)	CO1

Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Agents and Environments, Intelligent Agents, Typical Intelligent Agents, Problem Solving Approach to Typical AI problems.

Unit II	Problem Solving using Search Techniques	(08 hrs)	CO2

Problem solving agents, Searching for solutions, Uninformed search strategies, Breadth first search, Depth first search, Depth limited search, Bidirectional search, Heuristic search strategies, Greedy best -first search, A* search, Memory bounded heuristic search, Local search algorithms & optimization problems, Hill climbing search, Simulated Annealing.

Unit III	Adversarial search	(08hrs)	CO3

Games, Optimal Decisions in Games, Alpha-beta pruning. Constraint Satisfaction Problems (CSP), Defining CSP, Constraint Propagation, Inference in CSP, Backtracking Search for CSPs, Local Search for CSPs.

Unit IV	Logical Reasoning	(07 hrs)	CO4

Knowledge-based agents, Propositional Logic, First-order logic, syntax and semantics, knowledge representation and engineering, inferences in first-order logic, forward chaining, backward chaining, resolution.

Unit V	Knowledge Representation and Planning	(07 hrs)	CO5

Ontological Engineering, Categories and Objects, Events, Mental Events. Automated planning: Classical Planning, Algorithms for classical planning, Forward State-space search for planning, Backword State-space search for planning.

Text Books

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, University of California at Berkeley, Pearson education, 2020.
2. Vinod Chandra, A. Hareendran, Artificial Intelligence- principles and applications, PHI, Second Edition, 2021.

Reference Books

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
3. I. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth Edition, Addison-Wesley Educational Publishers Inc., 2011

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Quiz (10 marks will be converted to 4 marks)	4
4	Unit IV - Assignment (10 marks and will be converted to 4 marks)	4
5	Unit V - Assignment (10 marks and will be converted to 4 marks)	4
	Total	**20**

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: V
2301303 : 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: - 2301212: Data Structures

Companion Course : 2301304 : Database Management System Lab

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	3-Apply
CO3	Demonstrate ability to prepare logical design of database using ER model and normalization technique	3-Apply
CO4	Apply the concepts of database system architectures and NoSQL	3-Apply
CO5	Describe the concepts of transaction management used to maintain database consistency and reliability	2-Understand

COURSE CONTENTS

Unit I	**Relational Model and SQL**	**(08 hrs)**	**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 Rules

Unit II	**Advanced SQL and PLSQL**	**(06 hrs)**	**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**	**(08 hrs)**	**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**	**(08 hrs)**	**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**	**(06 hrs)**	**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", 6 th 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

3. C J Date, "An Introduction to Database Systems" ,Addison-Wesly, ISBN:0201144719
4. 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	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Assignment (10 marks will be converted to 4 marks)	4
3	Unit III - Assignment (10 marks will be converted to 4 marks)	4
4	Unit IV - Quiz (10 marks and will be converted to 4 marks)	4
5	Unit V - Quiz (10 marks and will be converted to 4 marks)	4
	Total	**20**

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T. Y. B. Tech. Computer Engineering **Pattern 2023 Semester: V** **2301304 : Database Management System Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Termwork: 25 Marks** **Practical Exam : 25 Marks**
Prerequisite Courses: 2301212: Data Structure		
Companion Course : 2301303 : 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	Develop SQL queries to perform data definition, manipulation, and control operations on relational databases.	3-Apply
CO2	Implement aggregate functions, joins, subqueries, and views using SQL to retrieve and manage complex data sets	3-Apply
CO3	Apply ER modeling concepts to design Entity Relationship (ER) diagrams for real-world scenarios	3-Apply
CO4	Write PL/SQL programs using procedures, functions, cursors, and triggers to automate database operations.	3-Apply
CO5	Build NoSQL-based database solutions using MongoDB to store, query, and process semi-structured data	3-Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	**SQL Queries** 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 same streets as do their managers. 6. Find all employees in the database who do not work for First Bank Corporation.	CO1

	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	**SQL Joins** 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. 5. Create a view containing total number of students whose instructor belongs to "Pune".	CO2
3	**ER Modelling and Normalization:** Conceptual Design using ER features using tools like ERDplus, ERWin etc. (Identifying entities, relationships between entities, attributes, keys, cardinalities, generalization, specialization etc.) Convert the ER diagram into relational tables and normalize the Relational data model.	CO3
4	**PL/SQL block** 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 5 per day b. If no. of days>30, per day fine will be Rs 50 per day 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.	CO4
5	**Database Trigger** Create a Library database with the schema Books(AccNo, Title, Author, Publisher, Count). a. Create a table Library_Audit with same fields as of Books and Date and status column b. Create a before trigger to insert records into Librry_Audit table if there is deletion in Books table, insert date of deletion and status as deleted Create a after trigger to insert records into Librry_Audit table if there is updation in Books table , insert date of updation and status as updated	CO4

6	**Database Connectivity**: Write a program to implement Menu driven MySQL/Oracle database connectivity with any front end language for Python/Java/PHP to implement Database navigation operations (add, delete, edit etc.)	CO1
7	**MongoDB Queries** 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 'Raj' or whose title is 'mongodb'. 6. Display all the documents whose title is 'mongodb' and written by 'Raj'. 7. Display all the documents whose like is greater than 10. 8. Display all the documents whose like is greater than 100 and whose the title is either 'mongodb' or written by 'Raj'. 9. Update the title of 'mongodb' document to 'mongodb overview' 10. Delete the document titled 'NoSQLoverview'. 11. Display exactly two documents written by 'Raj'. 12. Display the second document published by 'Raj'. 13. Display all the books in the sorted fashion. Insert a document using save method.	CO5
8	**MongoDB Aggregation and Indexing** 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 Raj. 2. Find books which have minimum likes and maximum likes published by Raj. 3. Find the average number of likes of the books published by Raj. 4. Find the first and last book published by Raj.. 5. Create an index on author name. Display the books published by Raj and check if it uses the index which we have created	CO5
9	**Mini Project:** Form a group of 3 or 4 students and Using the database concepts covered, develop an application with following details: 1. Define a problem statement 2. Follow the Software Development Life cycle and other concepts l earnt in Software Engineering Course throughout the implementation. 3. Develop application considering: Front End: Java/PHP/Python/.net/any other language Backend : MongoDB/ MySQL/Oracle 4. Test and validate applications using Manual/Automation testing.	CO1 to 5
Extra programming Problems		
1	**ER Modeling** Conceptual Design using ER features using tools like ERD plus, ER Win etc. (Identifying entities, relationships between entities, attributes, keys,	CO3

	cardinalities, generalization, specialization etc.) Convert the ER diagram into relational tables and normalize the Relational data model. ER model of a Hospital management using the following description . Each of these entities have their respective attributes which are − Patients - ID(primary key), name, age,visit_date Tests- Name(primary key), date, result Doctor- ID(primary key), name, specialization	
2	**SQL Queries** Consider the following schema account(acc-no,branch-name,balance) depositor(cust-name,acc-no) borrower (cust-name, loan-no) loan (loan - no, branch - name, amount) Write following queries using SQL 1. Create tables using proper primary keys 2. Update information of particular customer 3. Find the customers having loan less than 1 lac 4. Display account number and customer name starting with 'P' 5. Display name of the depositor with balance 6. Find names of all customers who have a loan at the 'Redwood branch'. 7. Find all customers who have an account and loan or both. 8. Find all customers who do not have loan 9. Find average account balance at each branch. 10. Find the name of borrower having maximum loan amount	CO1, CO2
3	**PLSQL Block** Write a Stored Procedure namely proc_Grade for the categorization of students. If marks scored by students in examination is <=1500 and marks>=990 then students will be placed in distinction category if marks scored are between 989 and 900 category is first class, if marks 899 n 825 category is Higher Second Class and Less than 825 and > 600 have 'Pass Class'. Insert the result in Result table for all Write a Stored Procedure for calculating Number of students getting each class e.g Distinction - 10 students, First class -5 students. Insert count in the Analysis table Write a PL/SQLblock to use procedures created with the above requirement. Stud_Marks(roll, name, total_marks) Result(Roll,Name, Class) Analysis(class , count)	CO4
4	Cassandra Queries: Design and Develop Queries using CRUD operations	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
Tools recommended: -MySQL, MongoDB, Python/PHP

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)

T. Y. B. Tech. Computer Engineering **Pattern 2023 Semester: V** **2301305: Data Structures and Algorithms Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Termwork: 25 Marks** **Practical:25 Marks**
Prerequisite Courses: - 2301215: Data structures Lab		

Course Objectives:

- To understand basic concepts of nonlinear data structures such as trees, graphs
- To learn advanced data structures such as indexing techniques and multiway search trees
- To analyze performance of different algorithmic strategies in terms of time and space

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, efficient indexing techniques and multiway search trees to store and maintain data	3-Apply
CO3	Apply the Greedy strategy to solve the fractional knapsack problem.	3-Apply
CO4	Apply Dynamic Programming or Branch and Bound strategy to solve the 0-1 knapsack problem.	3-Apply
CO5	Analyze the asymptotic performance of algorithm	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	**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
3	**Expression tree**: Write a menu driven C++ program to construct an expression tree from the given prefix expression e.g. +--a*bc /def and perform following operations: 1.Traverse it using Inorder, Preorder and Post order traversal (recursive and non-recursive) 2.Change a tree so that the roles of the left and right pointers are swapped at every node	CO1, CO5
4	**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.	CO2, CO5

	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	
5	Write a program to solve a fractional Knapsack problem using a greedy method.	CO3, CO5
6	Write a program to solve a 0-1 Knapsack problem using dynamic programming or branch and bound strategy. Or Write a program to solve a 0-1 Knapsack problem using dynamic programming or branch and bound strategy.	CO4, CO5
Mini Project		
	Design and implement an application oriented mini project on the concept of Graphs / Trees / Symbol table/ indexing techniques/ multiway tree in a group of students. Use different Algorithmic strategies for it.	CO1 to CO5
Extra programming Problems		
1	**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	CO1, CO5
2	**A Dictionary using STL map and Hashmap**: Implement Dictionary (key and value pairs) 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, CO5
3	**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
4	**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

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++/VC++

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.)

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

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: V
2301306A: Internet of Things

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

Prerequisite Courses: 2301206 Digital Electronics and Logic Design

Companion Course : 2301307A Internet of Things Lab

Course Objectives:

- To understand the fundamentals of the IoT system.
- To study various IoT protocols.
- To learn various elements of IoT security
- To use python programming in IoT

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

	Course Outcomes	**Bloom's Level**
CO1	Explain the characteristics and methodology to design IoT system	2-Understand
CO2	Identify various devices required for different IoT applications.	3-Apply
CO3	Describe various IoT protocols for communication between different endpoints to develop client server application.	2-Understand
CO4	Explain various elements of IoT Securities	2-Understand
CO5	Make use of various cloud offering available for IoT Platform	3-Apply

COURSE CONTENTS

Unit I	**Introduction to IoT and its Platforms Design Methodology**	**(09 hrs)**	**CO1**

Definition and characteristics of IoT, Applications, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges.

IoT Platform Design Methodology: Purpose and requirement specification, Process specification, Domain model specification, Information model specification, Service specifications level specification, Functional view specification, Operational view specification, Device and component integration, Application development

Unit II	**IoT Physical Devices and Programming Raspberry Pi with Python**	**(07 hrs)**	**CO2**

Basic building blocks of IoT device, Sensors and actuators, Connectivity technologies, Exemplary device: Raspberry Pi, Raspberry Pi interfaces, Beagle board and Other IoT Devices. **Programming Raspberry Pi with Python:** Working with digital and analog input output, Retrieving data from the real world with sensors, Working with accelerators, Temperature sensor, Displaying information and performing action using LCD and Servo motors, Working with cloud publishing data to the cloud-Python pub nub.

Unit III	**IoT Protocols**	**(07 hrs)**	**CO3**

Four pillars of IoT: M2M, WSN, SCADA and RFID. **Protocol Standardization for IoT**: Issues with IoT Standardization, Unified Data Standards.

IoT Protocols: IEEE 802.15.4, BACNet, Modbus, KNX, Zigbee, 6LoWPAN, LoRa

Unit IV	IoT Security	(06 hrs)	CO4
Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT.			
Unit V	**IoT Physical servers and Cloud offering**	**(07 hrs)**	**CO5**
Introduction to Cloud Storage Models, Communication API, WAMP: AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework: Djanjo, Amzon Web Services for IoT, SkyNet IoT Messaging Platform.			

Text Books

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012. ISBN: 9781439892992
3. Gastón C. Hillar, Internet of Things with Python Interact with the world and rapidly prototype IoT applications using Python
4. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011. ISBN: 978-3-642-19156-

Reference Books

1. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010, ISBN:10: 0521195330
2. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012, 9781119958345
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012, ISBN:978-1-119-99435-0
4. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010. ISBN: 978-0-470-90356-8
5. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014, ISBN: 978-1-118-43063-7

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Unit I - Written Test (10 marks and will be converted to 4 marks)	4
2	Unit II - Assignment (10 marks will be converted to 4 marks)	4
3	Unit III - Written Test (10 marks will be converted to 4 marks)	4
4	Unit IV - Quiz (10 marks and will be converted to 4 marks)	4
5	Unit V - Quiz (10 marks and will be converted to 4 marks)	4
	Total	**20**

T. Y. B. Tech Computer Engineering **Pattern 2023 Semester: V** **2301306B: Augmented Reality and Virtual Reality**		
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: - 2301212: Data Structures, 2301203: Computer Graphics, 2301215 Data Structures Lab , 2301205: Object Oriented Programming and Computer Graphics Lab.

Course Objectives:

- To study concepts of Augmented Reality
- To gain knowledge of various input and output devices required for interacting in virtual world
- To explain AR techniques
- To know Virtual Reality and its applications

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

	Course Outcomes	**Bloom's Level**
CO1	Explain the concepts of the Augmented Reality (AR).	2-Understand
CO2	Describe architecture of AR	2-Understand
CO3	Interpret different AR techniques	2-Understand
CO4	Describe fundamental principles of Virtual Reality (VR)	2-Understand
CO5	Outline Human Factors in VR Evaluations.	2-Understand

COURSE CONTENTS

Unit I	**Augmented Reality**	**(06 hrs)**	**CO1**

Introduction to Augmented Reality, History of Augmented Reality, Taxonomy, Technology and Features of Augmented Reality, Difference Between AR and VR, Challenges With AR, AR Systems and Functionality, Augmented Reality Methods, Visualization Techniques For Augmented Reality, Mobile Projection Interfaces.

Unit II	**AR & VR Architecture**	**(08 hrs)**	**CO2**

Audio Displays, Haptic Displays, Visual Displays, Visual Perception, Spatial Display Model. Tracking, Sensors Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

Unit III	**AR Techniques**	**(08hrs)**	**CO3**

Introduction to Marker Based Approach, Marker-Based Tracking, Types of Markers, Marker Camera Pose and Identification, Visual Tracking, Marker Types, Template Markers, 2D Barcode Markers, Imperceptible Markers.
Marker Less Approach, Localization Based Augmentation, Real World Examples, Tracking Methods Visual Tracking, Feature Based Tracking, Hybrid Tracking, Initialization and Recovery.

Unit IV	**Introduction to Virtual Reality**	**(08hrs)**	**CO4**

Introduction to Virtual Reality, The three I's of virtual reality, Commercial VR technology, five classic components of a VR system. Input Devices, Trackers, Navigation, Gesture Interfaces, Three-dimensional position trackers, Manipulation Interfaces, Output Devices, Graphics displays, Sound displays, Haptic feedback.

Unit V	VR Applications	(06hrs)	CO5
Testbed Evaluation of Universal VR Tasks, VR Health and Safety Issues, Direct Effects of VR Simulations on User, VR in social aspects. VR applications in industry, Medical applications, Military applications, Robotics applications.			

Text Books

1. Steve aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications and Human Factorsfor AR and VR, Adision Wesley.
2. Dr. Rajiv Chopra, Virtual and Augmented Reality, Khanna Book Publishing, 2021.

Reference Books

1. Burdea, G. C., P. Coffet., "Virtual Reality Technology", 2nd edition, Wiley-IEEE Press, 2006.
2. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
3. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
4. William R Sherman, Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", "The Morgan Kaufmann Series in Computer Graphics", Morgan Kaufmann Publishers, San Francisco, CA, 2002.

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Quiz (10 marks will be converted to 4 marks)	4
4	Unit IV - Assignment (10 marks and will be converted to 4 marks)	4
5	Unit V - Assignment (10 marks and will be converted to 4 marks)	4
	Total	**20**

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TY B.Tech Computer Engineering
Pattern 2023 Semester: V
2301306C: Software Testing and Quality Assurance

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: - 2301213:Software Engineering

Companion Course:- 2301307C: Software Testing and Quality Assurance Lab

Course Objectives

- To understand various software testing methodologies and their applications.
- To gain hands-on experience with test planning, case design, and defect tracking.
- To explore concepts of quality assurance in software processes.
- To emphasize testing strategies for modern software applications including web and mobile systems.
- To introduce standards and metrics for software quality.

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

	Course Outcomes	**Bloom's Level**
CO1	Describe software testing fundamentals, principles, and lifecycle	2 – Understand
CO2	Design and apply various software testing techniques	3 – Apply
CO3	Use automated tools and frameworks for functional and regression testing	3 – Apply
CO4	Understand software quality standards, metrics, and process models	2 – Understand
CO5	Evaluate software testing strategies for real-world applications	4 – Analyze

COURSE CONTENTS

Unit I	**Fundamentals of Software Testing**	**(06 hrs)**	**CO1**

Principles of software testing, Testing Life Cycle (STLC), Test Plan, Test Case, Bug Life Cycle, Types of testing: Functional, Non-Functional, Regression, Smoke, Sanity

Self-study: V-Model, Agile Testing Concepts

Unit II	**Testing Techniques and Strategies**	**(08 hrs)**	**CO2**

White-box testing: Basis path testing, Control flow testing, Black-box testing: Equivalence class partitioning, Boundary value analysis, Integration, System and Acceptance Testing, Test-Driven Development (TDD)

Unit III	**Automated Testing Tools and Frameworks**	**(08 hrs)**	**CO3**

Introduction to Selenium, JUnit, TestNG, Continuous Integration Tools: Jenkins, Automation frameworks – data-driven, keyword-driven, hybrid, Hands-on with test scripts and reports

Unit IV	**Software Quality Assurance and Metrics**	**(06 hrs)**	**CO4**

Software Quality: Definition, Goals, SQA Activities, Reviews, Audits, Quality Metrics: Defect Density, Mean Time to Failure (MTTF), Code Coverage

Self-study: Six Sigma and ISO Standards

Unit V	Current Trends and Case Studies	(08 hrs)	CO5
Web, Mobile, Cloud Application Testing, Security Testing and Performance Testing, Case Studies on Defect Management, Test Strategy Design, Emerging Trends: AI in Testing, DevTestOps			

Text Books

1. Srinivasan Desikan and Gopalaswamy Ramesh, Software Testing: Principles and Practices, Pearson Education
2. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, CRC Press
3. Rex Black, Foundations of Software Testing ISTQB Certification, Cengage Learning

Reference Books

1. Glenford Myers, Tom Badgett, Corey Sandler, The Art of Software Testing, Wiley
2. Aditya P. Mathur, Foundations of Software Testing, Pearson
3. Ron Patton, Software Testing, SAMS Publishing

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Quiz (10 marks will be converted to 4 marks)	4
4	Unit IV - Assignment (10 marks and will be converted to 4 marks)	4
5	Unit V - Assignment (10 marks and will be converted to 4 marks)	4
	Total	**20**

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T. Y. B. Tech. Computer Engineering **Pattern 2023 Semester: V** **2301307A: Internet of Things Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Continuous Comprehensive Termwork: 25 Marks** **Oral : 25 Marks**
Prerequisite Courses: 2301206 Digital Electronics and Logic Design, 2301207 Digital Electronics Lab		
Companion Course: 2301306A Internet of Things		

Course Objectives:

- To test the functionality of various sensors and actuators
- To use python for GPIO programming in IOT
- To develop client server application in IoT using various protocols

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

	Course Outcomes	**Bloom's Level**
CO1	Make use of various actuators and sensors available for sensing the real world	3-Apply
CO2	Design and construct IoT application for specified requirement	3-Apply
CO3	Apply various IoT protocols for communication between different endpoints to develop client server applications.	3-Apply
CO4	Construct an application for remote sensing, monitoring and controlling appliances.	3-Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Interface the I/O devices like LED, Switch, Buzzer to Raspberry Pi and write GPIO programming in python to test its functionality	CO1
2	Write an application to detect obstacles using Proximity sensor and notify the user using LED or Buzzer.	CO1, CO2
3	Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicates the user using LED or Buzzer.	CO1, CO2
4	Using the light sensor, monitor the surrounding light intensity and automatically turn on/off the high intensity LED by taking some predefined threshold light intensity value.	CO1, CO2
5	Display any RSS news feed headline on a LCD display connected to a device. Extract data from any website and flash it on an LCD	CO1, CO3
6	Interface the USB webcam with the device and capture the image .	CO1
7	Create an account on Thing speak cloud and write an application to publish the temperature information and interested applications can subscribe.	CO1, CO3
8	Create a simple web interface for Raspberry-Pi to control the connected LEDs remotely through the interface	CO1, CO3,CO4

9	Interface an Android smartphone with an Arduino /Raspberry pi via Bluetooth to control an LED from your phone.	CO1, CO3,CO4
10	Mini Project using Raspberry pi to identify and solve any real world problem	CO1 to 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.
Programming tools recommended: - Raspberry-Pi/Arduino

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)

T. Y. B. Tech Computer Engineering **Pattern 2023 Semester: V** **2301307B: Augmented Reality and Virtual Reality Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Term work: 25 Marks** **Oral Exam : 25 Marks**

Prerequisite Courses: - 2301212: Data Structures, 2301203: Computer Graphics, 2301215 Data Structures Lab , 2301205: Object Oriented Programming and Computer Graphics Lab.

Companion Course: 2301306B: Augmented Reality and Virtual Reality

Course Objectives:

- To study software and hardware requirements of AR and VR
- To get acquainted with methods of designing and rendering immersive environment
- To design and develop virtual reality tasks
- To evaluate VR application

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

	Course Outcomes	**Bloom's Level**
CO1	Make use of AR and VR development tools	2- Understand
CO2	Demonstrate the use of AR,VR and MR devices	3- Apply
CO3	Design and develop a game scene	6- create
CO4	Build AR and (or) VR application	6- create

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1.	Study of various AR & VR Development tools such as UNITY 3D IDE and its documentation.	CO1
2.	Create a C# script that plays a video when an image is scanned using AR App (AR Core & Unity).	CO3
3.	Develop & Deploy a simple marker-based AR app in which you have to write a C# program to play video on tracking a particular marker.	CO3,CO4
4.	Design and Develop the following using Vuforia Engine developer portal: I. Plane detection II. Marker based Tracking (Create database of objects to be tracked in Vuforia) III. Object Tracking and deploy it on AR devices.	CO3, CO4
5.	Demonstration of the working of HTC Vive, Oculus Quest 2, Microsoft Hololens2.	CO2
6.	Develop a scene in Unity that includes: I. A cube, plane and sphere, apply transformations on the 3 game objects. II. Add a video and audio source.	CO4

7.	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the color, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the color and Material/texture of the game objects dynamically on button click.	CO4
8.	Develop and deploy a VR app, Add interactive elements to the environment, such as objects that can be picked up, manipulated, or triggered by the user's actions.	CO4
9.	A. Create a multiplayer VR game (battlefield game). The game should keep track of score, no. of chances/lives, levels (created using different scenes), involve interaction, animation and immersive environment. OR B. Create a treasure hunt AR application which should have the following features: ● A help button for instruction box to appear ● A series of markers which would give hints on being scanned ● Involve interaction, sound, and good UI OR C. Evaluate an existing VR application or a VR game.	CO1 to 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.
Practice using AR & VR tools such Unity, Vuforia, Blender, Unreal.
Operating System recommended: - Linux or its derivative , Windows 10 and above
Programming tools recommended: - Open Source line gcc/g++/C#

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) (Coding standard, Indentation, Hungarian notation, input validation etc)

TY B. Tech Computer Engineering **Pattern 2023 Semester: V** **2301307C: Software Testing and Quality Assurance Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Term Work: 25 Marks** **Oral Exam : 25 Marks**

Prerequisite Courses: - 2301213: Software Engineering

Companion Course:- 2301306C: Software Testing and Quality Assurance

Course Objectives

- To understand various software testing approaches including manual and automation.
- To implement test planning, execution, and defect reporting processes.
- To explore quality assurance strategies and metrics.
- To use automation tools to streamline testing processes.

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

	Course Outcomes	**Bloom's Level**
CO1	Apply manual testing techniques to identify software bugs	3 – Apply
CO2	Design effective test cases based on requirements	3 – Apply
CO3	Automate test cases using testing tools like Selenium	3 – Apply
CO4	Analyze and document test results and quality metrics	4 – Analyze

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Perform functional testing for a sample application. Design and execute test cases. Document defects in a bug tracking sheet.	CO1, CO2
2	Design test cases using boundary value analysis and equivalence class partitioning for a module.	CO2
3	Implement and execute test cases using Selenium WebDriver for a login page.	CO3
4	Automate test suite using TestNG and generate test reports.	CO3
5	Evaluate test coverage and code quality using open-source tools (e.g., JaCoCo, SonarQube).	CO4
6	Simulate load testing using JMeter on a web application and analyze performance metrics.	CO4
7	Prepare a software test plan (STP) and test summary report (TSR) for a case study.	CO2, CO4
8	Conduct a defect analysis and prepare defect density and priority-severity matrix.	CO4

Guidelines for Laboratory Conduction

Use coding standards, indentation, and inline comments.
Use of open-source testing tools is encouraged.
Operating System: Linux or Windows
Recommended Tools: Selenium, JUnit/TestNG, JMeter, JaCoCo, SonarQube

Guidelines for Student's Lab Journal
Each lab assignment should be handwritten and include: - Title, problem statement, theory, algorithm, flowchart - Test cases and result observations - Conclusion, source code (printed), and outputs (screenshots/logs) - Journal should also have Certificate and Table of Contents
Guidelines for Term work Assessment
Assessment for each lab assignment will be based on: • R1 - Timely completion (10 Marks) • R2 - Understanding of assignment (10 Marks) • R3 - Presentation/clarity of journal writing (10 Marks)

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T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: V
2301308: Management Information Systems

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 02 hrs/week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses: - 2301218: Customer Relationship Management

Course Objectives:

- To understand concepts of Management Information System and Business intelligence for MIS.
- To recognize the need of an information system in today's global business with tools and technologies.
- To identify IT infrastructure components and to study security in the Information System.
- To understand the importance of project management and the international information system.
- To understand the concepts of decision support systems for business applications.

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

	Course Outcomes	**Bloom's Level**
CO1	Explain the concepts of management information system and business intelligence for MIS.	2-Understand
CO2	Illustrate the need of an information system using global business and ethical issues.	3-Apply
CO3	List the IT infrastructure components and explain security in the information system	2-Understand
CO4	Demonstrate the importance of project management and extend its use in the international information system	3-Apply
CO5	Illustrate the concepts of decision support systems for business applications.	3-Apply

COURSE CONTENTS

Unit I	**An Overview of Management Information System**	**(04 hrs)**	**CO1**

Management information system: Concept, Definition, Role of MIS, Impact of MIS, Management as a Control System: The functions of Management, Managerial Roles, The Levels of Management, Support to the Management, Management effectiveness and MIS, Organization as a System. Decision Making, Business intelligence for MIS.

Unit II	**Organization, Management and Network Enterprise**	**(05 hrs)**	**CO2**

Perspectives on Information System. Global E-business and collaboration: Business Processes, Types of Information Systems, Tools and technologies for collaboration and teamwork, E-mail and Instant Messaging, Social Networking, Virtual worlds, Internet based Collaboration Environments. Information system organization and strategy, Ethical and social issues in information system.

Unit III	**Information Technology Infrastructure**	**(05 hrs)**	**CO3**

IT infrastructure and Emerging Technologies: IT infrastructure and its components, Hardware and software platform trends, Management issues.
Foundation of Business intelligence: Databases and information management. Telecommunication, The Internet and Wireless technology, Securing information systems: system vulnerability, Business value of security and control.

Unit IV	**Key System Applications for Digital Age**	**(05 hrs)**	**CO4**

Enterprise Applications, E-Commerce: Digital Markets and Digital Goods, Managing knowledge, Enhancing Decision Making, Building information Systems, Managing project: The importance of project Management, the business value of information systems, Managing project risk, Managing Global Systems: The growth of international information systems, organizing international information systems, Technology issues and

opportunities for global value chain.

Unit V	Business Applications	(05 hrs)	CO5

Introduction to e-business systems: Functional Business systems, cross functional Enterprise systems. Customer Relationship Management: The Business focus, Enterprise Resource Planning: The business backbone, Supply chain Management: Business Network. Electronic Commerce Systems: Fundamentals, e-commerce applications and issues. Decision support systems: Decision support in Business, DSS Components, Data Mining for Decision Support, benefits and challenges in enterprise system.

Text Books

1. Waman S. Javadekar," Management Information System: A Global Digital Enterprise Perspective", McGraw Hill Education Pvt. Ltd. 5thEdition, ISBN– 13:978-1-25-902669-0.
2. James A.O' Brien, George MMarakas, "Management Information Systems", The McGraw-Hill Companies, 7th Edition, ISBN-0-07-062-003-2

Reference Books

1. Kenneth C. Laudon, Jane P. Laudon, "Management information Systems: Managing the Digital Firm", Perason, 12th Edition, ISBN-978-81-317-8746-5.
2. James A. O'Brien," Management Information Systems: Managing information Technology in the Business Enterprise", Tata McGraw Hill Edition, 6th Edition, ISBN- 0-07-058739-6.
3. Robert Schultheis, Marry sumner, "Management information system: The Manager's View", Tata McGraw Hill Edition, 4thEdition, ISBN-0-07-463879-3.
4. Gordon B. Davis, Margrethe H. Olson, "Management Information Systems: Conceptual Foundations, Structure and Development", Tata McGraw Hill Edition, 2ndEditon,ISBN-13:978-0-07-040267-6

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Quiz	10
2	Unit II - Quiz	10
3	Unit III - Quiz	10
4	Unit IV - Assignment	10
5	Unit V - Assignment	10
	Total	**50**

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: V
2301309: Computer Organization and Architecture

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: - 2301206: Digital Electronics and Logic Design

Course Objectives:

- To get familiar with basics of computer organization and architecture
- To explain the function of elements of memory hierarchy and compare different methods for computer Input /Output
- To understand the concept of processor organization

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

	Course Outcomes	**Bloom's Level**
CO1	Explain the functions & organization of building blocks of computer	2- Understand
CO2	Illustrate processor instruction characteristics and concepts related to Assembly Language Programming	2- Understand
CO3	Explain characteristics of memory systems and I/O devices	2-Understand
CO4	Illustrate the organization of computer processor	2-Understand
CO5	Compare hardwired and micro programmed control unit	2-Understand

COURSE CONTENTS

Unit I	**Introduction**	**(06 hrs)**	**CO1**

Introduction to computer organization and architecture, Structure and Function, Computer components, Computer functions, Interconnection structure, Bus interconnection

Unit II	**Instruction Set**	**(08 hrs)**	**CO2**

Machine Instruction Characteristics, Type of operands, Addressing Modes, Types of operations: Data transfer, Arithmetic, Logical, Conversion, I/O , Transfer of Control, Introduction to assembly language

Unit III	**Memory and Input/output**	**(08 hrs)**	**CO3**

Memory: Characteristics of memory systems, The memory hierarchy, Cache memory principles, Elements of cache design: Direct, Associative Mapping, Memory replacement algorithms
Input/Output: I/O Modules, Programmed I/O, Memory mapped I/O, Interrupt driven I/O, Direct Memory Access

Unit IV	**Processor Organization**	**(08 hrs)**	**CO4**

Processor Organization, Register Organization, Instruction Cycle, Instruction Pipelining, Superscalar Vs Super pipelined, Design Issues

Unit V	**Control Unit**	**(06 hrs)**	**CO5**

Control Unit and its Operation: Micro operation, Control of the processor, Hardwired Implementation, Micro programmed Control: Microinstruction, Microinstruction sequencing and execution

Text Books

W. Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Prentice Hall of India, 2010, ISBN 13: 978-0-13-607373-4

Reference Books
1. C. Hamacher, V. Zvonko, S. Zaky, “Computer Organization”, Fifth edition, McGraw Hill, 2002, ISBN: 007-120411-3 2. Morris Mano, “Computer System Architecture”, PHI, Third Edition, ISBN- 81-7808-687-5

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Quiz (10 marks will be converted to 4 marks)	4
4	Unit IV - Assignment (10 marks and will be converted to 4 marks)	4
5	Unit V - Assignment (10 marks and will be converted to 4 marks)	4
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik

(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: V
2301310: Project Based Learning

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

Course Objectives:

- To enable students to design innovative solutions for real-life problems through collaborative and critical thinking.
- To foster a hands-on, project-based learning approach that promotes lifelong learning and practical application.
- To develop teamwork and problem-solving skills required to address real-world technical challenges in multidisciplinary environments.

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

	Course Outcomes	Bloom's Level
CO1	Design solutions to real life problems and analyze its concerns through shared cognition.	3-Apply
CO2	Apply learning by doing an approach in PBL to promote lifelong learning.	3-Apply
CO3	Tackle technical challenges for solving real world problems with team efforts	3-Apply
CO4	Collaborate and engage in multi-disciplinary learning environments.	3-Apply

COURSE CONTENTS

This course is designed with weekly sessions consisting of one hour of tutorial and two hours of practical work. During tutorials, students will discuss key concepts, plan their projects, and clarify doubts. In practical sessions, students will actively work on their projects, apply their learning, and develop solutions in teams. Below are the weekly topics and activities outlined for tutorials and practical sessions.

Sr. No.	Tutorial (1 Hour) – *Discussion Focus*	Practical (2 Hours) – *Student Activities*
1	Introduction to PBL, course outcomes, evaluation process	Group formation, topic brainstorming, initial idea drafting
2	Identifying real-world problems and innovation scope	Finalize topic and project title, start background study
3	Patentability, literature survey, and problem definition	Prepare problem statement and requirement specification
4	Planning and timeline – Gantt chart, deliverables	Create Gantt chart, define milestones and phases
5	Conceptual and architectural design – flowcharts, diagrams	Draw system architecture, identify major modules
6	Domain-specific mentoring and tool introduction	Set up tools/environment, start basic development
7	Report writing and documentation guidelines	Begin writing design and implementation documents
8	Mid-stage review planning, progress check	Implementation of core modules, integrate feedback
9	Testing techniques, debugging, and validation methods	Perform unit and integration testing, document issues
10	Effective project demonstration and presentation skills	Rehearse demo, refine UI, prepare slides or posters
11	Ethical, social, and environmental considerations	Final report writing, include ethical impact statement
12	Self-assessment, peer feedback, final discussion	Final demonstration, submission of report and logbook

General Guidelines

1. Group Structure

Students will work in mentor-guided teams of 3 to 4 members to collaboratively plan and complete real-world projects.

2. Project/Problem Selection

Projects can be from any domain, preferably Computer Engineering. Ideas from first-year projects may be extended. Projects should focus on model development, software tools, and real-world relevance. Interdisciplinary, practical, and research-oriented problems are encouraged, including hands-on work, industry visits, and expert interactions.

3. Conduction

The mentor will monitor weekly progress and assess both individual and team contributions. Students are expected to show collaboration, self-motivation, and responsibility. Mentors and students must actively participate in evaluation, supported by institutional guidance and resources.

Evaluation and Continuous Assessment

Tutorial Evaluation (25 Marks)

- Participation in weekly discussions and reviews – 5 marks
- Maintenance of weekly logbook with progress updates – 5 marks
- Understanding of problem and project planning – 5 marks
- Presentation of progress during tutorials – 5 marks
- Self and peer assessment – 5 marks

Term Work Evaluation (25 Marks)

General Rubrics for Each Assignment (30 Marks)

- R1 – Timely Completion of Assignments (10 marks)
- R2 – Understanding of Assignment (10 marks)
- R3 – Presentation or Documentation (10 marks)

Text Books

1. Sharon J. Gerson, Steven M. Gerson, Technical Writing: Process and Product, Pearson Education Asia, ISBN :130981745, 4th Edition.
2. Andrea J. Rutherford, Basic Communication Skills for Technology, Pearson Education Asia, 2nd Edition.
3. Lesikar, Lesikar's Basic Business Communication, Tata McGraw, ISBN :256083274, 1st Edition.

Reference Books

1. Project-Based Learning, Edutopia, March 14,2016.
2. What is PBL? Buck Institute for Education.
3. www.schoology.com
4. www.howstuffworks.com

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

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: VI
2301311 : Data Science and Big Data

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:- 2301303 Database Management System

Companion Course :- 2301313 Data Science and Big data Lab

Course Objectives:

- To understand the data analytics life cycle
- To study big data characteristics and preprocessing techniques
- To get familiar with supervised and unsupervised learning algorithm

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

	Course Outcomes	**Bloom's Level**
CO1	Illustrate various data pre-processing techniques to simplify and speed up machine learning algorithms	2-Understand
CO2	Describe the working and characteristics of various regression algorithms	2-Understand
CO3	Explain the features and applications of different classification algorithms	2-Understand
CO4	Compare different clustering algorithms.	2-Understand
CO5	Identify the key stages of the data analytics life cycle and their purpose in solving data-driven problems	2-Understand

COURSE CONTENTS

Unit I	**Feature Engineering**	**(09 hrs)**	**CO1**

Concept of Features, **preprocessing of data:** Normalization and Scaling, Standardization, Managing missing values, Dimensionality Reduction, Feature Extraction: Principal Component Analysis(PCA), Kernel PCA, Local Binary Pattern. Feature Selection Techniques: Sequential Forward Selection, Sequential Backward Selection. Multidimensional Scaling, Matrix Factorization Techniques.

Unit II	**Regression**	**(06 hrs)**	**CO2**

Regression: Bias, Variance, Generalization, Underfitting, Overfitting, Linear regression, Logistic regression, Lasso regression, Ridge regression
Evaluation Metrics: MAE, RMSE, R2.

Unit III	**Classification**	**(09 hrs)**	**CO3**

Classification: K-nearest neighbor, Support vector machine, Decision Tree
Ensemble Learning: Bagging, Boosting, Adaboost. Binary-Vs -Multiclass Classification, Balanced and Imbalanced Multiclass Classification Problems, Variants of Multiclass Classification: One-vs-One and One-vs-All
Evaluation Metrics: Accuracy, Precision, Recall, Fscore, Cross-validation.

Unit IV	**UnSupervised Learning**	**(06 hrs)**	**CO4**

Cluster Analysis, Partition Methods K-Means, K-Medoids. Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering. Dynamic Clustering, Multi-view Clustering, Measuring Clustering Quality

Unit V	**Big Data and Analytics**	**(06 hrs)**	**CO5**

Data explosion, Sources of Big Data, Big Data Characteristics.

Data Analytic Lifecycle: Introduction, Phase 1: Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5: Communication results, Phase 6: Operationalize.

Text Books

1. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807
2. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publication, 2012, ISBN0-07-120413

Reference Books

1. EMC Education Services, "Data Science and Big Data Analytics- Discovering, analyzing Visualizing and Presenting Data"
2. 2. DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edition
3. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, (2020), ISBN: ISBN 978-1-108-47244-9
4. Wes McKinney, "Python for Data Analysis ", O' Reilly media, ISBN: 978-1-449-31979-3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Written Test (10 marks will be converted to 4 marks)	4
4	Unit IV - Written Test(10 marks and will be converted to 4 marks)	4
5	Unit V - Presentation (10 marks and will be converted to 4 marks)	4
	Total	**20**

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T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: VI
2301312: Theory of Computation

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: - 2301201: Discrete Structures

Companion Course: -

Course Objectives:

- To introduce the students about the basic concepts of formal language, natural language and finite state machines.
- To study abstract computing models to provide a formal connection between algorithmic problem solving and the theory of languages
- To understand Grammar, Pushdown Automata and Turing Machine for language processing and algorithm design
- To learn about the theory of computability and complexity for algorithm design

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

	Course Outcomes	**Bloom's Level**
CO1	Construct finite automata and regular expression, for given regular language and their inter conversion.	2-Understand
CO2	Classify between pumping lemma for regular expression and Context Free Grammar.	2-Understand
CO3	Construct Context Free Grammars and convert a given grammar in one form to other form	3-Apply
CO4	Construct Pushdown Automata for the given Context Free language	3-Apply
CO5	Construct Turing Machine for regular and non regular languages and understand the concept of different classes of problems	3-Apply

COURSE CONTENTS

Unit I	**Formal Language Theory and Finite Automata**	**(09 hrs)**	**CO1**

Basic Concepts: Symbols, Strings, Language, Formal Language, Natural Language. Basic Machine and Finite State Machine.
Finite Automata (FA): An informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language.
FA without output: Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA and inter-conversion.
FAwithoutput:MooreandMealymachines-Definition,models,inter-conversion

Unit II	**Regular Expressions**	**(06 hrs)**	**CO2**

Introduction, Operators of RE, Precedence of operators, Algebraic laws for RE, Language to Regular Expressions, Equivalence of two REs.
Conversions: RE to NFA, DFA, DFA to RE using Arden's theorem, Pumping Lemma for Regular languages, Closure and Decision properties of Regular languages
Case study: To study the use of RE in text processing systems for pattern matching

Unit III	Context Free Grammar (CFG)and Context Free Language (CFL)	(07hrs)	CO3

Basic Elements of Grammar, Formal Definition of Context Free Grammar, Sentential form, Derivation and Derivation Tree/ Parse Tree, Context Free Language (CFL), Ambiguous Grammar, writing grammar for language.

Simplification of CFG: Eliminating Є-productions, unit productions, useless production, and useless symbols.

Normal Forms: Chomsky Normal Form, Greibach Normal Form, Pumping Lemma for CFG, Closure properties of CFL

Unit IV	Pushdown Automata	(07hrs)	CO4

Introduction, Formal definition of PDA, Equivalence of Acceptance by Final State and Empty stack, Non-deterministic PDA (NPDA) and Deterministic PDA (DPDA), PDA and Context Free Language, Equivalence of PDA and CFG, PDA vs CFLs.

Unit V	Turing Machines	(07hrs)	CO5

Introduction, Formal definition of Turing Machines, Language Acceptability by Turing Machines, Universal Turing Machines, Multi-Tape Turing Machines, Multi-Stack Turing Machines, Multi-Track Turing Machines, Halting Problem of TM, Recursion Theorem

Complexity Classes: The Class P, The Class NP, Examples of problems in NP, NP-hard Problems.

Case Study : To study the use of Application of Halting problem in parallel computing

Text Books

1. Vivek Kulkarni, “Theory of Computation”, Oxford University Press, ISBN0-19-808458
2. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, “Introduction to Automata Theory Languages and Computation”, Addison-Wesley, ISBN 0-201-44124-1
3. Daniel Cohen, “Introduction to Computer Theory”, Wiley & Sons,ISBN97881265133454

Reference Books

1. Sanjeev Aroraand Boaz Barak, “Computational Complexity: A Modern Approach”, Cambridge University Press, ISBN: 0521424267 97805214242643

2. John Martin, “Introduction to Languages and The Theory of Computation”, 2nd Edition, McGraw Hill Education,ISBN-13:978-1-25-900558-9, ISBN-10: 1-25-900558-5

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Assignment (10 marks and will be converted to 4 marks)	4
2	Unit II - Assignment (10 marks will be converted to 4 marks)	4
3	Unit III - Assignment (10 marks will be converted to 4 marks)	4
4	Unit IV - Quiz (10 marks and will be converted to 4 marks)	4
5	Unit V - Quiz (10 marks and will be converted to 4 marks)	4
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Computer Engineering **Pattern 2023 Semester: VI** **2301313: Data Science and Big Data Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Termwork :25 Marks** **Practical Exam :25 Marks**
Prerequisite Courses: -2301304 Database Management Systems Lab		
Companion Course:- 23013111 Data Science and Big Data		

Course Objectives:

- To study data preprocessing techniques
- To compare performance of various classification algorithms
- To make use of clustering algorithms
- To develop a regression model and verify its performance
- To develop big data applications in order to understand its processing techniques

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

	Course Outcomes	**Bloom's Level**
CO1	Make use of data pre-processing techniques to simplify and speed up machine learning algorithms	3-Apply
CO2	Analyze the performance of classification algorithms for given datasets	4-Analyze
CO3	Compare the performance of clustering algorithms for given datasets	4-Analyze
CO4	Interpret the performance of regression algorithms for given datasets	4-Analyze
CO5	Evaluate Big Data processing and analytics techniques by developing and testing simple application	4-Analyze

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	For any five Datasets available in WEKA's Data directory, Load the Datasets one at a time using "Explorer" and fill-in the following tabl	**CO1**

Sr. No.	**Name of the Dataset**	**No. of Instances**	**No. Of Attributes**	**Type of Attributes (Numeric, Nominal or both)**	**Suitable for (Classification/Prediction, Clustering)**

Perform Classification on datasets available under WEKA's Data subfolder using KNN, Decision Tree and SVM.Use Train Set and Cross validation with 10 folds. Record your reading for each dataset as follows

	<table><tr><th>Sr. No.</th><th>Name of the Dataset</th><th>No. of Instances</th><th>No. Of Attributes</th><th colspan="4">Accuracy using (SVM, KNN, Decision Tree)</th><th colspan="4">Time required for Classification Using (SVM, KNN, Decision Tree)</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td colspan="4">AVG Accuracy and Time</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> Write your comments about Accuracy and time required for these classifiers c. Repeat experiment 2 b) above but this time using WEKA's Supervised Attribute filter, "Attribute Selection" and record your observations as given below and comment on the observations. <table><tr><th>Sr. No.</th><th>Name of the Dataset</th><th>No. of Instances</th><th>No. Of Attributes</th><th>No. of Attr after applying Filter</th><th colspan="4">Accuracy using (SVM, KNN, Decision Tree)</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td colspan="5">AVG Accuracy</td><td></td><td></td><td></td><td></td></tr></table> d. Repeat the experiment 2b) above but this time apply WEKA's in-built Instance Filter (Use "RemoveMissedClassified" filter) on original datasets and record your observations as given above only the 5th column will be titled as "No. of Instances after applying filter". Fill-in the observations and write comments e. Repeat the above experiment 2b) but this time by applying both Attribute as well as Instance filter, fill-in the table and write your comments.	
2	Perform the following operations using Python on any open source dataset 1. Import all the required Python Libraries. 2. Locate open source data from the web (e.g. https://www.kaggle.com). Provide a clear description of the data and its source (i.e., URL of the web site). 3. Load the Dataset into the panda data frame. 4. Display the initial statistics. 5. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them. 6. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them. 7. Apply data transformations on at least one of the variables. 8. Turn categorical variables into quantitative variables in Python.	CO1
3	Implement PCA Feature extraction technique on any data set	CO1
4	Create a **Linear Regression Model** using Python/R to predict home prices using Boston Housing Dataset (https://www.kaggle.com/c/boston-housing).	CO4
5	Implement **logistic regression** using Python/R to perform classification on Social_Network_Ads.csv dataset. Evaluate the model	CO4

6	Classify the email using the binary classification method. Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use **Support Vector Machine** classification algorithm for classification. Analyze its performance. Dataset: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-pam-classification-dataset-csv	CO2
7	Implement **KNN** classification algorithm using Python/R on iris.csv dataset. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.	CO2
8	Implement **K-Means clustering** on a dataset. Determine the number of clusters using the elbow method. Dataset: https://www.kaggle.com/datasets/kyanyoga/sample-sales-data or any dataset of your choice	CO3
9	Implement a simple Word Count application that counts the number of occurrences of each word in a given input set using the Hadoop Map-Reduce framework .	CO5
10	Develop a mini project for any data science application using any machine learning model. Use Python/R for implementation.	CO1 to 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: - Python

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 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)

K.K.Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech Computer Engineering
Pattern 2023 Semester: VI
2301314A: User Interface and User Experience

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: - 2301210: Design Thinking

Course Objectives:

- To study the usable software-enabled user-interfaces
- To achieve efficient, effective, and safe interaction
- To Explore various models and factors that affect response time
- To explore the challenges associated with information visualization and its societal and individual impacts.
- To learn Usability evaluation methods

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

	Course Outcomes	**Bloom's Level**
CO1	Understand the principles of User Interface	2 - Understand
CO2	Describe user experience fundamentals	2 - Understand
CO3	Explore strategies for managing design projects.	3 - Apply
CO4	Design user-friendly interaction styles and controls	3 - Apply
CO5	Test the usability of a design through usability evaluations	4 - Evaluate

COURSE CONTENTS

Unit I	**Introduction and Overview of UI**	**(08 hrs)**	**CO1**

The Human– I/P, O/P channels, Human Memory, thinking, emotion, individual difference (diversity), human psychology. **Introduction to User Interface Design (UI)** -The Relationship Between UI and UX, Roles in UI/UX,
A Brief historical Overview of Interface Design, Interface Conventions, Approaches to Screen Based UI, Template vs Content, Formal Elements of Interface Design, Active Elements of Interface Design, Composing the Elements of Interface Design, UI Design Process, Visual Communication design component in Interface Design, Application of UI design
Introduction to Design Technologies and Tools Sketch ,Wireframe , Invision, Axure, Figma, Flutter, Mockups

Unit II	**User Experience**	**(07 hrs)**	**CO2**

UX Basics- Foundation of UX design, Good and poor design, Understanding Your Users, Designing the Experience Elements of user Experience, Visual Design Principles, Functional Layout, Interaction design, Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design **User experience and user interaction** -Usability of interactive systems, goals and measures, Universal Usability, Characteristics of graphical and web user interfaces, guidelines, principles and theories of good design, **User Experience** - Concept of UX, Trends in UX, 6 Stages used to UX design , Applications of UX design

Unit III	**Design Process**	**(07 hrs)**	**CO3**

Managing design processes, organizational design to support usability, pillars of design, development methodologies, Human considerations in Design,
Usability- principles to support usability, assessment in the design process, Usability problems, practical

measures of usability,objective measures of usability, golden rules of interface design,
Evaluating Interface Design– Introduction, Expert reviews, Usability testing, Acceptance tests, Legal issues

Unit IV	**Interaction Styles and controls**	**(08 hrs)**	**CO4**

Interaction Styles- Direct manipulation and virtual environment, Develop system menus and navigation schemes-Structure of menus, Function of menus, content of menus, phrasing the menu, navigating menus, kinds of graphical menus, form fill-in and dialog boxes, command- organization , functionality, strategies and structure, naming and abbreviations, interaction devices, collaboration and social media participation.
Implementation support and Screen Based Controls

Unit V	**Usability Evaluation and Design Issues**	**(06 hrs)**	**CO5**

Quality of Service- Models of response time impacts, user productivity, variability in response time, Balancing function and fashion- Error messages, display design, web page design, window design, color,
Information visualization – Data type by task taxonomy, challenges for information visualization, societal and individual impact of user interface
Usability Evaluation Methods - Usability Testing , Heuristic evaluations , Cognitive walkthrough, Surveys and Questionnaires Eye Tracking, A/B Testing, Remote Usability Testing, Think-Aloud Protocol, Comparative Usability Evaluation Industry Trends and Case Studies, Professional practices and career opportunities in UI/UX design

Text Books

1. Creative Tim, “Fundamentals of Creating a Great UI/UX”, First Edition
2. Jon Yablonski, “Laws of UX: Using Psychology to Design Better Products & Services”, O'Reilly Media, Inc.", Apr-2020, First Edition
3. Jenifer Tidwell, Charles Brewer, Aynne Valencia “Designing Interfaces: Patterns for Effective Interaction Design", O'Reilly Media, Inc.", First Edition

Reference Books

1. Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface-Strategies for Effective Human Computer Interaction”, 5th Edition, PEARSON Publication, ISBN 97881317-3255-7
2. Wilbert O. Galitz “The Essential Guide to User Interface Design”, 2nd Edition, WILEY Publication, 9780471271390, 047127139X.
3. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, “Human–Computer Interaction, 3rd Edition, PEARSON education, 9788131717035, 8131717038
4. Alan Coopen, “The essentials of interaction”, Wiley , ISBN:9781568843223, 156884322

e-Books

1."The Guide to Wireframing" by UXPin: https://www.uxpin.com/studio/ebooks/guide-to-wireframing/ - This eBook provides an in-depth guide to wireframing, covering the basics, best practices, and tips for creating effective wireframes.
2."UX Design for Startups" by Marcin Treder: https://uxpin.com/studio/ebooks/ux-design-for-startups/ - This eBook focuses on UX design principles and strategies specifically tailored for startups, covering topics like user research, prototyping, and user testing.

MOOC Courses links :

https://onlinecourses.nptel.ac.in/noc21_ar05/preview

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Assignment (10 marks will be converted to 4 marks)	4
3	Unit III - Assignment (10 marks will be converted to 4 marks)	4
4	Unit IV - Quiz (10 marks and will be converted to 4 marks)	4
5	Unit V - Presentation (10 marks and will be converted to 4 marks)	4
	Total	**20**

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

T.Y. B. Tech. Computer Engineering Pattern 2023 Semester: VI 2301314B: Generative AI and Prompt Engineering		
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:- 2311302: Artificial Intelligence

Course Objectives:

- To study the role of prompt engineering in NLP model development.
- To understand the fundamentals of Generative Adversarial Networks (GANs).
- To acquire knowledge on how to use Generative AI techniques in software development.
- To understand language model architectures, training methods.

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

	Course Outcomes	**Bloom's Level**
CO1	Identify the role of NLP within AI contexts	3- Apply
CO2	Explain the fundamentals of Generative Adversarial Networks (GANs)	2- Understand
CO3	Identify role of Large Language Model for text generation	2- Understand
CO4	Make use of prompt engineering in advancements in NLP	3- Apply
CO5	Illustrate the techniques and Application for Prompt Engineering	2- Understand

COURSE CONTENTS

Unit I	**Natural Language Processing (NLP)**	**(10 hrs)**	**CO1**

Introduction to Natural Language Processing (NLP), Natural Language Understanding (NLU), Natural Language Generation (NLG), Applications of NLP, Challenges of NLP, Data preprocessing- Stemming and Lemmatization, Sentence Segmentation, Stop word removal, Tokenization, Byte Pair Encoding Algorithm, Text Feature extraction- Bag-of-Words, TF-IDF, Word2Vec, GLoVE,

Language Models: Statistical Model (n-Grams), Estimating n-gram probabilities, Evaluating Language Models, Knowledge based Models, Contextual language Models, Word Sense Disambiguation, Cosine Similarity and Word Meaning, Anisotropy: The Problem with Word Embedding, Neural Network Based Models (RNN, LSTM)

Unit II	**Generative AI Models**	**(6 hrs)**	**CO2**

Introduction to Generative AI, Types of Generative AI, Generative Adversarial Networks (GANs), Variational Auto-encoder (VAE), Diffusion Model, Reparameterization Trick, De-noising Diffusion Model, Ethical Considerations for using AI, Applications of Generative AI in Different Industries

Unit III	**Large Language Models (LLM) for Text Generation**	**(8 hrs)**	**CO3**

Large Language Model (LLM) and its stages, Vector/Token Representations / Embedding, Positional Embedding, Introduction to Attention Mechanism, Simplified Self attention, Self-Attention Mechanism, Causal Attention Mechanism, Multi Head Attention Mechanism, Transformer Architecture, Probabilistic Text Generation, Understanding BERT architecture and pre-training objectives, OpenAI's Generative Pre-Trained Transformers GPT-3.5-turbo, ChatGPT GPT-4, Google's Gemini, Meta's LLaMA

Unit IV	Prompt Engineering	(6 hrs)	CO4
Introduction to prompt engineering, Principles of Effective Prompts, Understanding the API parameters, Crafting Compelling Prompts, Generative Pre-trained Transformers (GPT) models, Tokens, Costs, tokens and initial prompts: how to calculate the cost of using a model, Vector DataBase, LangChain with RAG, LangChain with LLM Agents, Advanced Prompting Strategies (Like CoT, ReAct)			
Unit V	**Prompt Engineering Techniques & Applications**	**(6 hrs)**	**CO5**
Prompt Engineering Techniques- Zero shot & Few shot prompting, Chain of thought (COT), Automatic Chain of Thought (Auto- COT), Chain- of- Symbol (CoS), Tree- of- Thoughts (ToT), Graph of thoughts (GoT), Chain-of-Verification (CoVe), Chain- of- code (CoC), Application: Question- Answering Systems, Conversational AI, Sentiment Analysis, Template - Based Prompt Generation, Text Augmentation			

Text Books

1. Sebastian Raschka, "Build a Large Language Model (From Scratch)", September 2024, ISBN 9781633437166
2. David Foster, "Generative Deep Learning, 2nd Edition", April 2023, Publisher(s): O'Reilly Media, Inc., ISBN: 9781098134181
3. James Phoenix, Taylor, "Prompt Engineering for Generative AI", O'Reilly Media, Inc., ISBN: 9781098153434

Reference Books

1. Robert E. Miller, "Prompt Engineering Bible: Join and Master the AI Revolution", Independently Published, ISBN-13: 979-8861782944
2. Hobson Lane, Hannes Hapke, and Cole Howard, "Natural Language Processing in Action: Understanding, analyzing, and generating text with Python", Manning Publications,1st Edition, ISBN-13: 978- 1617294631
3. Scikit-Learn, Keras, and TensorFlow, "Hands-On Machine Learning", O'Reilly Media, 2nd Edition. ISBN-13: 978-9352139057
4. François Chollet, "Deep Learning with Python", Manning Publications, 2nd Edition, ISBN 9781617296864

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Assignment (10 marks and will be converted to 4 marks)	4
2	Unit II - Assignment (10 marks will be converted to 4 marks)	4
3	Unit III - Assignment (10 marks will be converted to 4 marks)	4
4	Unit IV - Quiz (10 marks and will be converted to 4 marks)	4
5	Unit V - Quiz (10 marks and will be converted to 4 marks)	4
	Total	**20**

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

T. Y. B. Tech. Computer Engineering **Pattern 2023 Semester: VI** **2301314C: High Performance Databases**		
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: - 2301303 : Database Management Systems

Companion Course: 2301316 : Programming Lab

Course Objectives:

- To provide in-depth knowledge of advanced concepts in database systems, including data models, database design techniques, and system architecture.
- To introduce and implement concepts of transaction management, concurrency control, and recovery techniques to ensure database consistency and reliability
- To understand the key performance metrics and system resources involved in database operations, including CPU, memory, disk I/O, and network usage.

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

	Course Outcomes	**Bloom's Level**
CO1	Explain the need for high-performance database systems	2-Understand
CO2	Apply traditional, distributed, and modern database architectures and models to enhance performance and scalability	3-Apply
CO3	Implement efficient data storage, retrieval, indexing, and query optimization strategies to improve database performance	3-Apply
CO4	Apply transaction management and concurrency control techniques to ensure consistency and high performance in traditional and distributed databases	3-Apply
CO5	Analyze Database Performance Metrics	4- Analyze

COURSE CONTENTS

Unit I	**Introduction to High-Performance Databases**	**(08 hrs)**	**CO1, CO2**

Introduction to High-Performance Databases: Overview of database systems, Importance of high performance in databases, Challenges in managing large-scale data, Trends and Emerging Technologies in High-Performance Databases.
Case Studies of High-Performance Database Implementations

Unit II	**Database Architecture and Models**	**(07 hrs)**	**CO2**

Database Architecture: Overview of traditional database architectures, Introduction to distributed database systems, Distributed Database Systems and Scalability, Data Partitioning and Sharding Techniques, Replication Strategies for High Availability and Fault Tolerance, Architectural considerations for high performance
Data Models and Query Languages: Relational data model and SQL, NoSQL databases (e.g., document-oriented, key-value, columnar), New SQL databases

Unit III	**Data Storage and Retrieval**	**(07 hrs)**	**CO3**

Data Storage and Retrieval for High Performance: Storage engines and data organization, Techniques for efficient data retrieval, Compression and encoding methods.

Indexing and Query Optimization: Indexing techniques for high-performance queries, Query optimization strategies, Parallel and Distributed Query Execution.
In-Memory Databases: Advantages and challenges of in-memory databases, Memory management and data durability, Comparison with traditional disk-based databases.

Unit IV	Concurrency Control, Transaction Management	(08 hrs)	CO4

ACID Properties of Transactions, Concurrency Control Mechanisms (e.g., Locking, Multi-Version Concurrency Control), Distributed Transaction Management, Isolation Levels and Consistency Models:, Concurrency control mechanisms (e.g., locking, MVCC), Distributed transaction management, Real-time Transaction Systems, Long-duration Transactions .

Unit V	Performance Monitoring and Tuning	(06 hrs)	CO5

Performance Monitoring and Tuning: Performance Metrics and Monitoring Tools, Strategies for performance tuning and optimization, Query Tuning and Optimization Techniques
Case Studies and Real-World Applications: Analysis of high-performance databases in use by tech companies, Case studies on handling large-scale data in various domains (e.g., social media, finance, e-commerce)

Text Books

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, “Database System Concepts”, 6 th Edition Tata McGraw Hill Publishers, ISBN 0-07-120413-X.
2. Baron Schwartz, Peter Zaitsev, and Vadim Tkachenko, "High Performance MySQL: Optimization, Backups, and Replication", O′Reilly, ISBN-1449314287

Reference Books

1. Martin Kleppmann , "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems"
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	Unit I - Quiz (10 marks will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Quiz (10 marks will be converted to 4 marks)	4
4	Unit IV - Written test (10 marks and will be converted to 4 marks)	4
5	Unit V – Assignment (10 marks and will be converted to 4 marks)	4
	Total	**20**

T. Y. B. Tech. (Computer Engineering)
Pattern 2023 Semester: VI
2301315A: Cloud Computing

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

Prerequisite Courses: - 2301216: Data Communicationand Networking

Course Objectives:

- To understand the concepts of Cloud Computing.
- To learn Taxonomy of Virtualization Techniques.
- To learn Cloud Computing Architecture.
- To acquire knowledge on Aneka Cloud Application Platform.
- To learn Industry Cloud Platforms.

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

	Course Outcomes	**Bloom's Level**
CO1	**Explain** the fundamental concepts and architecture of cloud computing	2-Understand
CO2	**Describe** various enterprise and cloud storage systems and their role in distributed data management.	2-Understand
CO3	**Summarize** the concepts of virtualization, its types, architecture, and its integration with cloud computing infrastructure.	2-Understand
CO4	**Illustrate** how cloud platforms like AWS and Google Cloud support real-world applications in fields	2-Understand
CO5	**Discuss** the risks, challenges, and security measures related to data confidentiality, integrity, and availability in the cloud.	2-Understand

COURSE CONTENTS

Unit I	**Introduction**	**(06 hrs)**	**CO1**

Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into The Cloud, Seven-step model of migration into a Cloud, Trends in Computing. Cloud Service Models: SaaS, PaaS, IaaS, Storage. Cloud Architecture: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models

Unit II	**Data Storage and Cloud Computing**	**(08 hrs)**	**CO2**

Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud file system (gfs and hdfs) Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage

Unit III	**Virtualization in Cloud Computing**	**(08hrs)**	**CO3**

Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. Grid, Cloud and Virtualization: Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.

Unit IV	**Cloud Platforms and Cloud Applications**	**(08hrs)**	**CO4**

Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). Cloud Computing Applications: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud

Application: Google App Engine.Overview of OpenStack architecture.

Unit V	Security in Cloud Computing	(06hrs)	CO5

Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. Data Security in Cloud: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.

Text Books

1.A. Srinivasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3

2. Gautam Shrof, "Enterprise Cloud Computing Technology Architecture and Applications", Cambridge University Press, ISBN: 9780511778476

Reference Books

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing",
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Tim Mather, Subra K, Shahid L.,"Cloud Security and Privacy", Oreilly, ISBN-13 978-81-8404-815-5
4. Dr. Kumar Saurabh, "Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms", Wiley publication, ISBN: 9788126570966
5. Rishabh Sharma, "Cloud Computing: Fundamentals, Industry Approach and Trends", Wiley publication

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Assignment (10 marks will be converted to 4 marks)	4
3	Unit III - Assignment (10 marks will be converted to 4 marks)	4
4	Unit IV - Quiz (10 marks and will be converted to 4 marks)	4
5	Unit V - Quiz (10 marks and will be converted to 4 marks)	4
	Total	**20**

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: VI
2301315B: Natural Language Processing

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: - 2301201: Discrete Structures

Course Objectives:

- To be familiar with fundamental concepts and techniques of Natural Language Processing (NLP)
- To acquire the knowledge of various morphological, syntactic, and semantic NLP tasks
- To use appropriate tools and techniques for processing natural languages
- To describe applications of NLP and Machine Translations

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

	Course Outcomes	**Bloom's Level**
CO1	Describe the fundamental concepts of NLP, challenges and issues in NLP	2-Understand
CO2	Describe the concepts of morphology, syntax, semantics of natural languages	2-Understand
CO3	Analyze and study natural language logically	2-Understand
CO4	Apply information retrieval techniques	3. Apply
CO5	Develop real world NLP applications	3. Apply

COURSE CONTENTS

Unit I	**Introduction to NLP**	**(08 hrs)**	**CO1**

Introduction: Natural Language Processing, Why NLP is hard? Programming languages Vs Natural Languages, Are natural languages regular? Finite automata for NLP, Stages of NLP, Challenges and Issues(Open Problems) in NLP
Basics of text processing: Tokenization, Stemming, Lemmatization, Part of Speech Tagging

Unit II	**Word Level and Syntactic Analysis**	**(08 hrs)**	**CO2**

Word Level Analysis: Regular Expressions- Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing,
Word Sense Disambiguation: Lesk Algorithm Walker's algorithm, WordNets for Word Sense Disambiguation

Morphological Analysis: What is Morphology? Types of Morphemes, Inflectional morphology & Derivational morphology, Morphological parsing with Finite State Transducers (FST)
Syntactic Analysis: Syntactic Representations of Natural Language, Parsing Algorithms, Probabilistic context-free grammars, and Statistical parsing

Unit III	**Semantic Analysis Language Modelling**	**(06hrs)**	**CO3**

Semantic Analysis: Lexical Semantic, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, WordNet, Dictionary based approach, Latent Semantic Analysis
Discourse Processing: Introduction, Cohesion, Reference Resolution, Discourse Coherence and Structure Probabilistic language modeling, Markov models, Generative models of language, Log-Linear Models, Graph-based Models
N-gram models: Simple n-gram models, Estimation parameters and smoothing, Evaluating language models, Word Embeddings/ Vector Semantics: Bag-of-words, TFIDF, word2vec, doc2vec, Contextualized representations (BERT)
Topic Modelling: Latent Dirichlet Allocation (LDA), Latent Semantic Analysis, Non Negative Matrix Factorization

Unit IV	**Information retrieval, NLP Tools and Techniques**	**(08hrs)**	**CO4**

Information Retrieval: Introduction, Vector Space Model, Design features of Information Retrieval Systems, Models of Information Retrieval
Named Entity Recognition: NER System Building Process, Evaluating NER System
Entity Extraction, Relation Extraction, Reference Resolution, Coreference resolution, Cross Lingual Information Retrieval
Prominent NLP Libraries: Natural Language Tool Kit (NLTK), spaCy, TextBlob, Gensim etc. Linguistic Resources: Lexical Knowledge Networks, WordNets, Indian Language WordNet (IndoWordnet), VerbNets, PropBank, Treebanks, Universal Dependency Treebanks

Unit V	**Applications of NLP**	**(06 hrs)**	**CO5**

Machine Translation: Rule based techniques, Statistical Machine Translation (SMT), Cross Lingual Translation
Sentiment Analysis, Chatbots and Virtual Assistants, Question Answering, Text Entailment, Named Entity Recognition (NER), Discourse Processing, Dialog and Conversational Agents,Text Summarization, Grammar and Spell Checking, Natural Language Generation

Text Books

1. U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Jurafsky, David, and James H. Martin, ―Speech and Language Processing: An Introduction to Natural Language Processing‖, Computational Linguistics and Speech Recognition‖, , PEARSON Publication
3. Manning, Christopher D., and nrich Schütze , ―Foundations of Statistical Natural Language Processing‖, Cambridge, MA: MIT Press

Reference Books

1. Allen James, Natural Language Understanding, Pearson India, 2nd Edition ISBN: 9788131708958, 8131708950
2. James H. Martin, Daniel Jurafsky, Speech and Language Processing Pearson 1stAddition, ISBN 9789332518414
3. Steven Bird, Ewan Klein, Edward Loper, ―Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit‖, O'Reilly Publication
4. Alexander Clark, Chris Fox, and Shalom Lappin, ―The Handbook of Computational Linguistics and Natural Language Processing‖, Wiley Blackwell Publications
5. Jacob Eisenstein, ―Natural Language Processing‖, MIT Press
6. Jacob Eisenstein, ―An Introduction to Information Retrieval‖, Cambridge University Press

Strength of CO-PO PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	3	3
CO2	3	2	2	2	-	2	-	-	-	-	-	2	3	3
CO3	3	2	2	-	-	2	-	-	-	-	-	2	3	3
CO4	3	3	3	-	-	2	-	-	-	-	-	2	3	3
CO5	3	3	3	3	-	2	-	-	-	-	-	2	3	3
Average	3	2.5	2.5	2.5	-	2	-	-	-	-	-	2	3	3

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 each of 15 marks (Total marks will be converted to 15 Marks)	15
2	Theory assignment on Unit-3 and Unit 5 each of 10 marks (Total marks will be converted to 5 Marks)	5
	Total	**20**

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: VI
2301315C: High Performance Computing

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: - 2301212: Data Structures

Course Objectives:

- To understand different parallel programming models
- To analyze the performance and modeling of parallel programs
- To illustrate the various techniques to parallelize the algorithm
- To study parallel communication operations.
- To discriminate CUDA Architecture and its components.

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

	Course Outcomes	**Bloom's Level**
CO1	Explain the scope of parallel computing and architectures	2-Understand
CO2	Interpret parallel algorithm principles and models	2-Understand
CO3	Illustrate data communication operations on various parallel architecture	2-Understand
CO4	Identify performance parameter for parallel computing system	3- Apply
CO5	Explain CUDA architecture & its applications in parallel programming	2-Understand

COURSE CONTENTS

Unit I	**Parallel Computing**	**(08 hrs)**	**CO1**

Parallel Computing: Motivation and Scope
Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Communication Costs in Parallel Machines, Scalable design principles
Architectures: N-wide superscalar architectures, Multi-core architecture.

Unit II	**Parallel Algorithm Design**	**(08 hrs)**	**CO2**

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing
Parallel Algorithm Models: Data model, Task model, Work Pool model and Master Slave Model,
Complexities: Sequential and Parallel Computational Complexity

Unit III	**Parallel Communication**	**(06 hrs)**	**CO3**

Basic Communication Operations: One-to-All Broadcast, All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter, Gather, All-to-All Personalized Communication, Circular Shift

Unit IV	**Analytical Modeling of Parallel Programs**	**(08 hrs)**	**CO4**

Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, The effect of Granularity on Performance
Matrix Computation: Matrix-Vector Multiplication, Matrix-Matrix Multiplication

Parallel Search Algorithms: Depth First Search(DFS), Breadth First Search (BFS)
Parallel Sorting: Bubble sort and Merge sort

Unit V	CUDA Architecture	(06 hrs)	CO5

Introduction to GPU: Introduction to GPU Architecture overview, Introduction to CUDA C- CUDA programming model, write and launch a CUDA kernel, Handling Errors, CUDA memory model, Manage communication and synchronization, Parallel programming in CUDA- C.

Text Books

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Seyed H. Roosta, “Parallel Processing and Parallel Algorithms Theory and Computation‖”, Springer-Verlag 2000, ISBN 978-1-4612-7048-5 ISBN 978-1-4612-1220-1
3. John Cheng, Max Grossman, and Ty McKercher, “Professional CUDA C Programming”, John Wiley & Sons, Inc., ISBN: 978-1-118-73932-7

Reference Books

1. 1.Kai Hwang,” Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. David Culler Jaswinder Pal Singh,” Parallel Computer Architecture: A Hardware/Software Approach”, Morgan Kaufmann,1999, ISBN 978-1-55860-343-1
4. Rod Stephens, “Essential Algorithms”, Wiley, ISBN: 978-1-118-61210-1

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Assignment (10 marks will be converted to 4 marks)	4
4	Unit IV - Assignment (10 marks and will be converted to 4 marks)	4
5	Unit V – Quiz (10 marks and will be converted to 4 marks)	4
	Total	**20**

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: VI
2301316: Programming Lab

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

Prerequisite Course: - As per Program Elective Course II, Program Elective Course III

Companion Courses: - Program Elective Course II, Program Elective Course III

Course Objectives:

- To study the fundamentals in selected elective subject.
- To design and develop a system / application
- To study modern tools, technologies, and techniques.

Course Outcomes

On completion of the course, students will be able to-

Sr.No	CO Statement	Blooms Taxonomy
2301314A:User Interface and User Experience Design		
1	Apply UI/UX design tools like Wireframe, Mockup, and Figma to identify user-specific needs	3-Apply
2	Use effective user interfaces / user experiences	3-Apply
2301314B: Generative AI and Prompt Engineering		
1	Make use of ethical considerations and technical challenges related to manipulating images.	3-Apply
2	Make use of the techniques and Application for Prompt Engineering	3-Apply
2301314C: High Performance Databases		
1	Apply indexing techniques to improve query performance	3-Apply
2	Make use of transaction management techniques to optimize the performance of database	3-Apply
2301315A: Cloud Computing		
1	Use tools and techniques in the area of Cloud Computing	3-Apply
2	Use cloud computing services for problem solving	3-Apply
2301315B: Natural Language Processing		
1	Apply text pre-processing techniques on given text.	3-Apply
2	Apply syntactic analysis on given text	3-Apply
2301315C: High Performance Computing		
1	Apply techniques to assess the performance of sequential and parallel algorithm	3-Apply
2	Design and develop solutions for multicore/Distributed/parallel environments.	3-Apply

Guidelines for Student's Laboratory 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) (Coding standard, Indentation, Hungarian notation, input validation etc).
Guidelines for Laboratory Conduction
Encourage the use of open-source software and widely accepted industry tools to promote hands-on skills. Recommended Softwares: Figma (Free), Penpot (Open-source, HTML/CSS/JS, Python (with Keras, TensorFlow, PyTorch), OpenAI API, DALL·E, LangChain, MySQL, PostgreSQL, SQLite, C++, phpMyAdmin, , Apache Cassandra, CloudSim, KVM (Linux), VirtualBox, Google Cloud Platform (Free Tier), AWS Educate, OpenStack, Salesforce Dev, NLTK, spaCy, gensim, scikit-learn, NLP, Google Colab, OpenMP, MPI (OpenMPI), C++, GCC/G++

Suggested List of Laboratory Experiments/Assignment		
Sr. No.	**All assignments are compulsory**	**COs**
	2301314A: User Interface and User Experience Design	
1	Apply UI/UX design tools such as Wireframe, Mockup, and Figma to study a selected product/system, identify specialized user needs and associated facilities, and suggest improvements for enhanced accessibility design	CO1, CO2
2	Design user persona for the users of selected product / system. How To Create A User Persona (Video Guide) - YouTube How to Create A User Persona in 2022 [FULL GUIDE] - YouTube	CO1, CO2
3	**Create Low-Fidelity and High-Fidelity Wireframes:** Start by sketching low-fidelity wireframes for each page using pen and paper or any digital tool you prefer. Focus on the layout, placement of key elements, and overall structure. Use basic shapes and placeholders to represent different elements such as navigation menus, search bars, images, buttons, and form fields. Aim for simplicity and clarity in your wireframes. **Refine High-Fidelity Wireframes:** Transfer your low-fidelity wireframes to a digital wireframing tool such as Adobe XD, Sketch, Figma, or any other tool you are comfortable with. Create high-fidelity wireframes that incorporate more details, accurate text, and realistic representations of UI components. Pay attention to typography, color schemes, and spacing to improve visual hierarchy and user experience.	CO1, CO2
4	Wireframes & Mockups: To create at least one wireframe, and one mockup of a web application. Your wireframe(s) and mockup will need to be responsive and take into account a desktop view and a mobile view.	CO1, CO2
	2301314B: Generative AI and Prompt Engineering	
1	Generate an image/ text with the fashion MNIST database using an auto-encoder	CO1
2	Building and training a very simple LLM from scratch.	CO1
3	Generate an AI- Image using DALL·E 2 API using Python.	CO2
4	Use Open AI API to craft a perfect AI Image Prompt	CO2
	2301314C: High Performance Databases	
1	Write a C++ Program to implement B- Tree index	CO1
2	Write MYSQL queries for database securities	CO1
3	Optimize poorly performing SQL queries using optimization techniques such as query rewriting, index selection, query plan analysis and measure performance.	CO2
4	Simulate transaction management by implementing any 2 concurrency control protocols	CO2
	2301315A: Cloud Computing	
1	Installation and Configuration of virtualization using KVM	CO1,CO2
2	Installation and configure Google App Engine.	CO1,CO2
3	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.	CO1,CO2
4	Creating an Application in SalesForce.com using Apex programming Language.	CO1,CO2
	2301315B: Natural Language Processing	
1	Perform tokenization (Whitespace, Punctuation-based, Treebank, Tweet, MWE) using NLTK library. Use porter stemmer and snowball stemmer for stemming.	CO1

	Use any technique for lemmatization.	
2	Perform bag-of-words approach (count occurrence, normalized count occurrence), TF-IDF on data. Create embeddings using Word2Vec.	CO2
3	Perform text cleaning, perform lemmatization (any method), remove stop words (any method),label encoding. Create representations using TF-IDF. Save outputs.	CO2
4	POS Taggers For Indian Languages	CO2
	2301315C: High Performance Computing	
1	Design and implement parallel algorithm to 1. Add two large vectors 2. Multiply a Vector and a Matrix 3. Multiply two Matrices	CO1, CO2
2	Design and implement Parallel Breadth First Search and Depth First Search based on existing algorithms using OpenMP. Use a Tree or an undirected graph for BFS and DFS.	CO1, CO2
3	Design and implement sequential and parallel algorithms for Bubble Sort and Merge sort using OpenMP. Compare the performance of sequential and parallel algorithms.	CO1, CO2
4	Use Parallel Reduction method to implement Min, Max, Sum and Average operations.	CO1,CO2

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: VI
2301317: Microcontroller and Embedded 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: - 2301206: Digital Electronics and Logic Design

Course Objectives:

- To get familiar with 8051 microcontroller
- To understand instruction set and assembly language programing of 8051
- To use C programming to write 8051 programs
- To study features of 8051 microcontroller
- To get introduced to embedded systems

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

	Course Outcomes	Bloom's Level
CO1	Explain basics of 8051 microcontroller	2-Understand
CO2	Make use of instruction set to write simple assembly language programs of 8051	3-Apply
CO3	Make use of C to write simple 8051 Programs	3-Apply
CO4	Explain features of 8051 microcontroller	2-Understand
CO5	Illustrate basics of embedded systems	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Microcontroller**	**(06 hrs)**	**CO1**

Difference between microprocessor and microcontroller, Introduction to the Microcontroller, Features and block diagram of 8051 and explanation, Program Status Word (PSW), Programmers model-register set, register bank, SFRs

Unit II	**8051 Assembly Language Programming and I/O Port Programming**	**(08 hrs)**	**CO2**

Addressing modes, Introduction to 8051 assembly programming, Structure of assembly language, instruction set: Jump, Loop , Call, arithmetic , logic instructions, 8051 I/O Port Programming

Unit III	**8051 Programming in C**	**(08 hrs)**	**CO3**

Why program the 8051 in C? , Data types and time delay in 8051 C, I/O Programming in 8051 C, Logic Micro operation in 8051 C, Data Conversion programs in 8051 C

Unit IV	**8051 memory, interrupts and timers/counters**	**(08 hrs)**	**CO4**

Memory organization on-chip data memory, External data memory and program memory, Memory interfacing-external RAM/ROM interface. CPU timings, Interrupt structure, 8051 Timers/counters, operation modes of 8051 and their programming

Unit V	**Embedded Systems**	**(06 hrs)**	**CO5**

Introduction to Embedded systems, Characteristics, Challenges, Processors in Embedded systems, Application Domain, Real time systems, Real time task, Hardware Units and devices in an embedded system

Text Books

1. Muhammad Ali Mazidi and Janice Gillispie Mazidi, Rolin McKinlay, The 8051 Microcontroller and embedded systems, 2009, Pearson education
2. V Udayashyankara, M S Mallikarjunaswamy, 8051 Microcontroller, The McGraw Hill Companies
3. Lyla B. Das, Embedded Systems: An Integrated Approach Pearson, ISBN: 9332511675, 9789332511675

4. Raj Kamal, Embedded Systems: Architecture, programming and Design, 2nd Edition, McGraw-Hill, ISBN: 13: 9780070151253

Reference Books

K. J. Ayala, D. V. Gadre , The 8051 Microcontroller and Embedded systems using Assembly and C., Cengage learning, ISBN 9788131511053

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Unit I - Quiz (10 marks and will be converted to 4 marks)	4
2	Unit II - Quiz (10 marks will be converted to 4 marks)	4
3	Unit III - Quiz (10 marks will be converted to 4 marks)	4
4	Unit IV - Assignment (10 marks and will be converted to 4 marks)	4
5	Unit V - Assignment (10 marks and will be converted to 4 marks)	4
	Total	**20**

TY B.Tech Computer Engineering
Pattern 2023 Semester: VI
2301318: Project Planning and Management

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 02 hrs/week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses: - 2301213: Software Engineering

Course Objectives

- To understand the fundamentals of project management and life cycle phases.
- To develop skills in planning, scheduling, and controlling software projects.
- To introduce tools and techniques used in project estimation and monitoring.
- To provide awareness on risk and quality management in software projects.
- To introduce contemporary approaches like Agile and DevOps for project execution.

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

	Course Outcomes	**Bloom's Level**
CO1	Describe the phases and characteristics of project management life cycle	2 – Understand
CO2	Apply estimation techniques and schedule a project using charts and tools	3 – Apply
CO3	Identify and manage risks and ensure quality in software projects	3 – Apply
CO4	Use project management tools for tracking progress and performance	3 – Apply
CO5	Explain modern methodologies like Agile, Scrum, and DevOps in project execution	2 – Understand

COURSE CONTENTS

Unit I	**Introduction to Project Management**	**(04 hrs)**	**CO1**

Definition and characteristics of a project, Project Life Cycle and Process Groups, Role of Project Manager and Stakeholders

Self-study: Triple Constraint (Scope, Time, Cost)

Unit II	**Project Planning and Estimation**	**(05 hrs)**	**CO2**

Project Scope Management and WBS, Effort estimation techniques: Function Point, Use Case, COCOMO-II, Activity scheduling using Gantt Charts, Network Diagrams, Critical Path Method (CPM) and PERT

Unit III	**Risk and Quality Management**	**(05 hrs)**	**CO3**

Risk Identification, Analysis and Mitigation, Software Quality Assurance and Control, Quality Standards: ISO, CMMI

Self-study: Risk Register and Case Study Analysis

Unit IV	**Project Monitoring and Tools**	**(05 hrs)**	**CO4**

Progress and Performance Tracking, Earned Value Management (EVM), Project Management Tools: MS Project, JIRA, Trello, Project Communication and Reporting

Unit V	**Agile and Contemporary Practices**	**(05 hrs)**	**CO5**

Agile Project Management: Principles and Manifesto, Scrum Framework: Roles, Ceremonies, Artifacts Kanban, Extreme Programming (XP), DevOps Practices in Project Execution

Text Books

1. Bob Hughes, Mike Cotterell, Rajib Mall, Software Project Management, 6/e, McGraw Hill Education
2. Kathy Schwalbe, Information Technology Project Management, 8/e, Cengage Learning
3. Pankaj Jalote, Software Project Management in Practice, Pearson Education

Reference Books
1. Harold Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Wiley 2. S.A. Kelkar, Software Project Management, PHI Learning 3. Agile Practice Guide, Project Management Institute (PMI)

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Unit I - Quiz	10
2	Unit II - Quiz	10
3	Unit III - Quiz	10
4	Unit IV - Assignment	10
5	Unit V - Assignment	10
	Total	**50**

T. Y. B. Tech. Computer Engineering
Pattern 2023 Semester: VI
2301319 : Full Stack

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Tutorial: 01 hrs/week **Practical: 02 hrs/week**	**02**	**Tutorial: 25 Marks** **Oral: 25 Marks**

Prerequisite Courses: - 2301303: Database Management Systems,
2301304: Database Management Systems Lab

Course Objectives:

- To introduce students to the architecture and technologies involved in full stack web development.
- To develop the ability to build frontend and backend components using modern tools and frameworks.
- To enable students to integrate databases and deploy full stack web applications.

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

	Course Outcomes	Bloom's Level
CO1	Understand the components and workflow of full stack development	2-Understand
CO2	Develop responsive web pages using HTML, CSS, and JavaScript	3-Apply
CO3	Build dynamic frontend using frameworks like React.js, Vue.js, or Bootstrap	3-Apply
CO4	Implement backend services and RESTful APIs using Node.js and Express	3-Apply
CO5	Connect applications with MongoDB and deploy them on platforms like Render/Vercel	3-Apply

COURSE CONTENTS

This course is designed with weekly sessions consisting of one hour of tutorial and two hours of practical work. During tutorials, students will understand important concepts, technologies, and workflows involved in full stack development. The practical component is structured through a series of progressive assignments, each designed to help students build and integrate different parts of a full stack web application.

Unit I	**Introduction to Full Stack Development**	**(02 hrs)**	**CO1**

Overview of full stack web development: frontend, backend, and database. Client-server architecture and RESTful APIs Introduction to development tools: VS Code, Git & GitHub, Postman Overview of web technologies: HTML, CSS, JavaScript, Node.js, Express, MongoDB

Unit II	**Front End Development using HTML, CSS, and JavaScript**	**(03 hrs)**	**CO2**

HTML5: semantic tags, structure, forms,CSS3 fundamentals: box model, Flexbox, Grid, media queries, JavaScript basics: variables, functions, event handling, DOM manipulation, Basics of responsive web design

Unit III	**Frontend Framework – Choice-Based (React.js / Vue.js / Bootstrap)**	**(03 hrs)**	**CO3**

Introduction to selected frontend framework, Components, props, and state management, Functional vs class components (if applicable),Basic routing (React Router/Vue Router/Bootstrap Navigation)
Introduction to hooks or equivalent (e.g., useState, useEffect in React)

Unit IV	**Backend Development using Node.js and Express**	**(02 hrs)**	**CO4**

Introduction to Node.js and Express.js,Setting up a server, routing, and middleware, REST API development: CRUD operations, Testing APIs using Postman

Unit V	**Database Integration and Deployment**	**(02 hrs)**	**CO5**

Introduction to NoSQL and MongoDB, Mongoose for schema definition and database operations Connecting backend with MongoDB, Application deployment: GitHub integration and hosting on Render/Vercel/Netlify

Sr. No.	List of Laboratory Assignments/ Experiments	COs Mapped
1	**Environment Setup and Requirement Gathering** ➢ Install tools: VS Code, Git, Postman, Node.j ➢ Choose frontend technology: **Option A:** Vanilla HTML, CSS, JavaScript **Option B:** React.js **Option C:** Vue.js ➢ Choose backend technology: **Option A:** Node.js with Express **Option B:** Any other backend framework allowed by instructor (optional) ➢ Identify a client/organization needing a website. ➢ Collect and document requirements.	**CO1**
2	**Build Basic Frontend Page** ➢ Create a static homepage using chosen frontend tech. ➢ Display a welcome message: "Welcome to [Client Name] Website." ➢ Practice responsive design basics.	**CO1**
3	**Interactive Frontend Form** ➢ Build a form with inputs: Name, Email, Gender (radio), Age, DOB, State (dropdown), Skills (checkbox). ➢ On submit, display entered data dynamically on the same page. ➢ Use framework-specific methods for interactivity (e.g., React state, Vue data binding, or plain JS DOM).	**CO3**
4	**Backend API Development & Database Integration** ➢ Use chosen backend tech to create RESTful APIs for form data submission and retrieval. ➢ Connect to MongoDB using Mongoose for data storage. ➢ Implement CRUD operations.	**CO3**
5	**Full Project Integration & Deployment (Mini Project)** ➢ Integrate frontend with backend APIs for full dynamic interaction. ➢ Test APIs with Postman. ➢ Deploy app on platforms like Netlify (frontend) and Render/Heroku (backend). ➢ Demo the complete application fulfilling the client requirements.	**CO2, CO3, CO4, CO5**

General Guidelines

Students are expected to maintain a detailed lab journal documenting all assignments, including a certificate page, table of contents, and handwritten write-ups. Each entry should clearly state the assignment title, problem statement, key concepts, system or data flow diagrams, step-by-step implementation, and test cases with expected results. Program codes along with sample outputs must be submitted separately in soft copy. Throughout the course, students should use open-source tools and recommended IDEs, follow best coding practices with clean, well-commented, and organized code, and employ version control systems like Git for collaboration. This structured approach ensures better understanding, effective project management, and smooth integration of frontend and backend components in full stack development.

Guidelines for Term work Assessment

The continuous assessment of laboratory work will be based on the student's overall performance throughout the term. Each laboratory assignment will be evaluated using a rubric that considers three key criteria:

- R1: Timely completion of the assignment (10 marks)
- R2: Understanding and comprehension of the assignment (10 marks)
- R3: Presentation quality and clarity of the journal write-up (10 marks)

This approach ensures a fair and comprehensive evaluation of both practical skills and documentation.

Text Books

1. Jon Duckett, *"Web Design with HTML, CSS, JavaScript and jQuery Set"*, Wiley, 1st Edition (2014)
2. Nicholas C. Zakas, *"Professional JavaScript for Web Developers"*, Wrox (Wiley), 3rd Edition (2012)
3. Ethan Brown, *"Web Development with Node and Express: Leveraging the JavaScript Stack"*, O'Reilly Media, 2nd Edition (2019)

Reference Books

1.Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development", Addison-Wesley Professional, 2nd Edition (2017)

2.Azat Mardan, "Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB", Apress, 1st Edition (2015)

3.Chris Minnick and Eva Holland, "Beginning HTML5 and CSS3 for Dummies", Wiley, 1st Edition (2013)

4.Eric Freeman and Elisabeth Robson, "Head First HTML and CSS", O'Reilly Media, 2nd Edition (2012)

5.Eric Elliott, "Programming JavaScript Applications: Robust Web Architecture with Node, HTML5, and Modern JS Libraries", O'Reilly Media, 1st Edition (2014)

TY B. Tech Computer Engineering
Pattern 2023 Semester: VI
2301320: Research Seminar

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Term Work: 50 Marks**

Prerequisite Courses: - Basics of literature survey, technical writing, and communication skills

Course Objectives

- To explore recent trends and research developments in computer engineering.
- To develop skills in identifying and reviewing quality research literature.
- To improve skills in technical report writing and formal presentation.
- To foster independent thinking and scholarly discussion among students.
- To encourage ethical practices in research and academic integrity.

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

	Course Outcomes	**Bloom's Level**
CO1	Identify a relevant research topic and formulate objectives	3 – Apply
CO2	Survey and critically review published research literature	4 – Analyze
CO3	Prepare a structured technical report using proper citations	3 – Apply
CO4	Present technical content clearly and respond to peer/faculty queries	3 – Apply
CO5	Demonstrate ethical research practices and academic honesty	2 – Understand

Seminar Guidelines

- Each student shall select a research topic in consultation with a faculty guide.
- The topic must be relevant to current trends in computer engineering or interdisciplinary areas.
- Students must perform a comprehensive literature survey using reputed journals and conference papers.
- Each student must submit a well-documented seminar report following standard formatting guidelines (IEEE/ACM).
- Students must deliver a PowerPoint-based seminar presentation in front of a review panel.
- Evaluation will be based on continuous assessment, quality of report, and final presentation.

Guidelines for Term work Assessment

Assessment will be based on:

1. Topic Selection & Synopsis (Relevance, Innovation, Clarity of Objectives) – 10 Marks
2. Literature Survey (Coverage, Analysis, Proper Referencing) - 10 Marks
3. Seminar Report (Structure, Formatting, Plagiarism-Free) - 10 Marks
4. Presentation Delivery (Content, Clarity, Confidence, Handling Q&A) - 10 Marks
5. Overall Participation & Timeliness (Progress, Regularity, Faculty Feedback) - 10 Marks