VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

B. Sc. Computer Science

(B.Sc. CS)

Curriculum

(AY 2024-2025 Admitted Students)

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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- **World class Education**: Excellence in education, grounded in ethics and critical thinking, for improvement of life.
- **Cutting edge Research**: An innovation ecosystem to extend knowledge andsolve critical problems.
- **Impactful People**: Happy, accountable, caring and effective workforce andstudents.
- **Rewarding Co-creations**: Active collaboration with national & international industries & universities for productivity and economic development.
- **Service to Society**: Service to the region and world through knowledge andcompassion.

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE ENGINEERING AND INFORMATION SYSTEMS

- To be a center of excellence in education and research in Information and Technology, producing global leaders for improvement of the society

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE ENGINEERING AND INFORMATION SYSTEMS

- To provide sound fundamentals, and advances in Information Technology, Software Engineering, Digital Communications and Computer Applications by offering world class curricula.
- To create ethically strong leaders and trend setters for next generation IT.
- To nurture the desire among faculty and students from across the globe to perform outstanding and impactful research for the benefit of humanity and, to achieve meritorious and significant growth.

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B. Sc. Computer Science

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. To equip the students with the skills and knowledge to get employment in the software industry as well as government departments by imparting the requisite technical skills.

2. To build the capability to work harmoniously as team members be able to become entrepreneur**,** leadership positions in the industry, with ethical responsibility.

3. To motivate them to pursue higher education in renowned universities across the globe.

PROGRAMME OUTCOMES (POs)

PO_01: Having a clear understanding of the subject related concepts and of contemporary issues

PO_02: Having problem solving ability- solving social issues and computer domain specific problems

PO_03: Having adaptive thinking and adaptability

PO_04: Having a clear understanding of professional and ethical responsibility

PO_05: Having cross cultural competency exhibited by working in teams

PO_06: Having a good working knowledge of communicating in English

PO_07: Having interest in lifelong learning

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B. Sc. (Computer Science) programme , graduates will beable to

1. PSO1: Ability to understand the programming concepts and methodologies in the field of computer science and apply the algorithmic, mathematical and scientific reasoning to solve wide range of computational problems

2. PSO2: Ability to use the emerging software development techniques and tools of computer science to provide real time solutions for latest applications.

CREDIT STRUCTURE

Category-wise Credit distribution

Programme Credit Structure	Credits	B.Sc (Honours)
Discipline Core Courses	60	80
Discipline Elective Courses	24	32
Ability Enhancement Courses	08	08
Skill Enhancement Elective Courses	09	09
Value Added Courses	08	08
Open Elective Courses	09	09
Project and Internship	02	14
Total Graded Credit Requirement	**120**	**160**

Note : * Students those who wish to continue for the fourth year have to complete three courses (12 Credits) from 4th level Courses in Discipline Elective basket to meet the credit requirement to become eligible for "Honours" degree.

Discipline Core Courses

S. No.	Course Code	Course Title	L	T	P	C
1	UMAT101L	Discrete Mathematics	3	0	0	3
2	UMAT102L	Probability and Statistics	3	0	0	3
3	UMAT201L	Linear Algebra	3	0	0	3
4	UCSC101L	Programming in Python	3	0	0	3
	UCSC101P	Programming in Python Lab	0	0	2	1
5	UCSC102L	Software Engineering	3	0	0	3
6	UCSC103L	Computer Organization and Architecture	3	1	0	4
7	UCSC104L	Data Structures and Algorithms	3	0	0	3
	UCSC104P	Data Structures and Algorithms Lab	0	0	2	1
8	UCSC105L	Object Oriented Programming	3	0	0	3
	UCSC105P	Object Oriented Programming Lab	0	0	2	1
9	UCSC201L	Operating Systems	3	0	0	3
	UCSC201P	Operating Systems Lab	0	0	2	1
10	UCSC202L	Database Management Systems	3	0	0	3
	UCSC202P	Database Management Systems Lab	0	0	2	1
11	UCSC203L	Computer Networks	3	0	0	3
	UCSC203P	Computer Networks Lab	0	0	2	1
12	UCSC204L	Programming in Java	3	0	0	3
	UCSC204P	Programming in Java Lab	0	0	2	1
13	UCSC205L	Web Development	3	0	0	3
	UCSC205P	Web Development Lab	0	0	2	1
14	UCSC206L	Full Stack Application Development	3	0	0	3
	UCSC206P	Full Stack Application Development Lab	0	0	2	1
15	UCSC301L	Software Testing	3	0	0	3
	UCSC301P	Software Testing Lab	0	0	2	1
16	UCSC398J	Project	0	0	0	4
					Total Credits	**60**

Discipline Honours Core Courses

S.No.	Course Code	Course Title	L	T	P	C
1	UCSC401L	Design and Analysis of Algorithms	3	0	0	3
	UCSC401P	Design and Analysis of Algorithms Lab	0	0	2	1
2	UCSC402L	Theory of Computation	3	1	0	4
3	UCSC403L	Natural Language Processing	3	1	0	4
4	UCSC404L	High Performance Computing	3	1	0	4
5	UCSC405L	Optimization Techniques	3	1	0	4
					Total Credits	**20**

Discipline Elective Courses

S.No.	Course Code	Course Title	L	T	P	C
1	UCCA116L	Organizational Behaviour	3	0	0	3
2	UCSC207L	Visual Programming	3	0	0	3
	UCSC207P	Visual Programming Lab	0	0	2	1
3	UCSC208L	Linux programming	3	0	0	3
	UCSC208P	Linux programming Lab	0	0	2	1
4	UCSC209L	Data Mining	3	0	0	3
5	UCSC210L	Software Project Management	3	0	0	3
6	UCSC211L	Object Oriented Analysis and Design	3	0	0	3
7	UCSC302L	Mobile Application Design and Development	3	0	0	3
	UCSC302P	Mobile Application Design and Development Lab	0	0	2	1
8	UCSC303L	Cloud Application Development	3	0	0	3
	UCSC303P	Cloud Application Development Lab	0	0	2	1
9	UCSC304L	Internet of Things	3	0	0	3
	UCSC304P	Internet of Things Lab	0	0	2	1
10	UCSC305L	Game Programming	3	0	0	3
	UCSC305P	Game Programming Lab	0	0	2	1
11	UCSC306L	Soft Computing	3	0	0	3
12	UCSC307L	Cyber Forensics	3	0	0	3
13	UCSC308L	Wireless Networks	3	0	0	3
14	UCSC309L	Edge Computing	3	0	0	3
15	UCSC310L	Advanced Java Programming	3	0	0	3
	UCSC310P	Advanced Java Programming Lab	0	0	2	1
16	UCSC406L	Computer Graphics and Multimedia	3	0	0	3
	UCSC406P	Computer Graphics and Multimedia Lab	0	0	2	1
17	UCSC407L	System Programming	3	0	0	3
	UCSC407P	System Programming Lab	0	0	2	1
18	UCSC408L	Robotics	3	1	0	4
19	UCSC409L	Cyber Physical Systems	3	1	0	4
20	UCSC410L	Augmented Reality and Virtual Reality	3	1	0	4
21	UCSC411L	Blockchain Technologies	3	1	0	4
22	UCSC412L	Malware Analysis	3	1	0	4

Discipline Elective Courses (Artificial Intelligence and Machine Learning)

S.No.	Course Code	Course Title	L	T	P	C
1	UCSC311L	Artificial Intelligence	3	1	0	4
2	UCSC312L	Machine Learning	3	0	0	3
	UCSC312P	Machine Learning Lab	0	0	2	1
3	UCSC313L	Image Processing	3	0	0	3
	UCSC313P	Image Processing Lab	0	0	2	1
4	UCSC314L	Deep Learning	3	0	0	3
	UCSC314P	Deep Learning Lab	0	0	2	1
5	UCSC315L	Human Computer Interaction	3	1	0	4
6	UCSC316L	Computer Vision	3	1	0	4

Discipline Elective Courses (Data Science)

S. No.	Course Code	Course Title	L	T	P	C
1	UCSC312L	Machine Learning	3	0	0	3
	UCSC312P	Machine Learning Lab	0	0	2	1
2	UCSC317L	Big Data Technologies	3	0	0	3
	UCSC317P	Big Data Technologies Lab	0	0	2	1
3	UCSC318L	Exploratory Data Analytics	3	0	0	3
	UCSC318P	Exploratory Data Analytics Lab	0	0	2	1
4	UCSC319L	Data Visualization	3	1	0	4
5	UCSC320L	NoSQL Databases	3	0	0	3
	UCSC320P	NoSQL Databases Lab	0	0	2	1
6	UCSC321L	Social Network Analytics	3	1	0	4

Ability Enhancement Courses

S No	Course Code	Course Name	L	T	P	C
1	UENG101L	Effective English Communication	2	0	0	2
2	UENG102L	Technical English Communication	2	0	0	2
3	UENG102P	Technical English Communication Lab	0	0	2	1
4	UIFL100L	Indian/Foreign Language	3	0	0	3
Total credits						08

Skill Enhancement Courses

S No	Course Code	Course Name	L	T	P	C
1	USTS101P	Qualitative Skills	0	0	3	1.5
2	USTS102P	Quantitative Skills	0	0	3	1.5
3	USTS201P	Advanced Competitive Coding -I	0	0	3	1.5
4	USTS202P	Advanced Competitive Coding -II	0	0	3	1.5
5	UENG201L	Content Writing	3	0	0	3
6	UCCA321L	Digital Marketing	3	0	0	3
7	UCSC226L	Animation and VFX	3	0	0	3
Total credits						09

Value added Courses

S No	Course Code	Course Name	L	T	P	C
1	USSC101L	Indian Constitution	2	0	0	2
2	UCHY101L	Environmental Science	2	0	0	2
3	UCSC225L	Cyber Security	3	0	0	3
4	UCXC100V	Co-Curricular Course	0	0	0	1
Total credits						08

Open Elective Courses

Management | Humanities | Science | Social Sciences

Total credits 09

Project and Internship

S No	Course Code	Course Name	C
1	UCSC399J	Summer Internship	2
2	UCSC499J	Research Project/Dissertation	12
Total credits			**14**

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DISCIPLINE CORE COURSES

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Course Code	Course Title	L	T	P	C
UCSC101L	Programming in Python	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To design and apply programming constructs in Python
2. To learn the usage of decision statements, looping statements and loop manipulation in Python
3. To apply string and file handling functions for solving real world problems

Course Outcomes:

1. Understand and comprehend the basic programming constructs of Python programming
2. Implement a given algorithm using Python's building blocks and control structures
3. Demonstrate the implications of specialized data structures in Python
4. Solve real time problems using Strings and Regular Expressions
5. Develop applications using functions and file handling mechanism in python

Module:1	**Introduction and Parts of Python**	**7 hours**

History of Python, Unique features of Python, Demo on IDLE, Jupiter, Spyder, Identifiers, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, reading input, Print output, Type Conversions

Module:2	**Control Flow Statements**	**5 hours**

Decision control flow statements, Loops: while loop, for loop, Continue and break statements

Module:3	**List and Tuples**	**6 hours**

Lists - Create, Basic list operations, Indexing and Slicing in Lists, Built-in functions used on lists, List methods, the del method, List comprehensions; Tuples - Create, Basic tuple operations, Indexing and Slicing in tuples, Built-in functions used on tuples, Relation between Lists and Tuples, Tuple methods

Module:4	**Dictionaries & Sets**	**6 hours**

Dictionary - Create, accessing and modifying key:value pair in dictionaries, built in functions used in dictionaries, dictionary methods, the del method; Sets - Creation and operations, Sets methods, Frozenset

Module:5	**Strings & Regular Expressions**	**7 hours**

Creating and Storing strings, Basic string operations, accessing characters by index, String slicing and Joining, String methods, Formatting strings; Regular Expressions – Using special characters, Regular expression methods, Named groups in Python regular Expressions, Regular Expression with glob module

Module:6	**Python Functions**	**6 hours**

Functions – Built in functions, commonly used modules, Function definition and calling the function, The return statement and void function, Scope of variables, Default parameters, Keyword arguments, Command line arguments, Lambda Function

Module:7	**Files and Packages**	**6 hours**

Files – Types of files, Crating and Reading text data, File methods to read and write data, Reading and writing files; Packages – Basics of NumPy and pandas.

Module:8	**Contemporary Issues**	**2 hours**

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Gowrishankar S. Veena A, “Introduction to Python Programmin”,2019, First Edition, CRC press.
Reference Books	
1.	Martic C Brown,“Python: The Complete Reference”,2018, Fourth Edition, McGraw Hill Publishers.
2.	Eric Matthes,“Python Crash Course: A Hands-On, Project-Based Introduction to Programming”,2023, Third Edition, No starch Press.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Course Code	Course Title	L	T	P	C

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UCSC101P	Programming in Python Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To design and apply programming constructs in Python
2. To learn the usage of decision statements, looping statements and loop manipulation in Python
3. To apply string and file handling functions for solving real world problems

Course Outcomes:

1. Understand and comprehend the basic programming, control structures and functions
2. Demonstrate the implications of specialized data structures in Python
3. Solve real-time problems using Strings and Regular Expressions
4. Develop applications using strings and file handling mechanisms in Python

	Indicative Experiments	**Hours**
1.	Python Operators, Expressions and Flow controls	4 Hours
2	Pythons List, Tuples	6 Hours
3.	Dictionaries & Sets	4 Hours
4.	Python Strings & Regular Expressions	6 Hours
5.	Python Functions and Files	6 Hours
6.	Python Packages	4 Hours
	Total Laboratory Hours	**30 Hours**

Text Book(s)

1	Gowrishankar S. Veena A., “Introduction to Python Programming”, 2019, First Edition, CRC press.
2	Eric Matthes, “Python Crash Course: A Hands-On, Project-Based Introduction to Programming”, 2023, Third Edition, No starch Press.

Mode of assessment: CAT, Exercises, FAT

Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Course Code	**Course Title**	**L**	**T**	**P**	**C**

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UCSC102L	Software Engineering	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand the fundamental concepts of software engineering process, product and project
2. To develop appropriate knowledge of requirements specification and design solutions for the given problem
3. To examine the quality standards in the software development process

Course Outcomes:

1. Demonstrate the basics of software engineering process, ethics, and development
2. Illustrate the concept of various process models, activities, and its improvements
3. Analyze the various aspects of software requirement engineering and system models
4. Summarize and analyse the decisions about the system architectural design process
5. Inspect a computer-based system to meet the desired needs of the customer with proper understanding of the critical systems development

Module:1	**Introduction to Software Engineering**	**5 hours**

Professional software development- Software engineering ethics, Software process models, Process activities, Coping with change, Process improvement

Module:2	**Requirements Engineering**	**5 hours**

Functional and non-functional requirements- Requirements Engineering Process- Requirements elicitation- Requirements Specification-Requirements Validation-Requirements change

Module:3	**Architectural Design and Modeling**	**7 hours**

System modeling-Context models- Interaction Models-Structural Models-Behavioural models-Model-driven architecture- Architectural design decisions-Architectural Views-Architectural patterns, and Application architectures- Object-oriented design using UML-Design patterns-Implementation Issues-Open source development

Module:4	**Validation and Evolution**	**7 hours**

Development testing, Test-driven development- Release testing, User Testing-Evolution processes- Legacy Systems-Software Maintenance-Software Reuse

Module:5	**Software Project Management**	**7 hours**

Risk management- managing people-Teamwork-Project planning- Software Pricing-Plan-driven development-Project Scheduling-Agile Planning-Estimation techniques- COCOMO cost modeling

Module:6	**Software Quality Management**	**6 hours**

Software quality- Software standards- Reviews and inspections-Quality management-Software measurement

Module:7	**Software Configuration Management**	**6 hours**

Version management-System Building-Change management- Release management

Module:8	**Contemporary Issues**	**2 hours**

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	**45 hours**

Text Book(s)

1. Ian Sommerville, "Software Engineering", 2017, Tenth Edition, Addison-Wesley.

Reference Books			
1.	Roger S. Pressman and Bruce Maxim, "Software Engineering", 2019, Seventh Edition, McGraw Hill.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	30-05-2023		
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Course Code	Course Title	L	T	P	C
UCSC103L	Computer Organization and Architecture	3	1	0	4
Pre-requisite		**Syllabus version**			
		V.1.0			

Course Objectives:

1. To understand computer design and data processing
2. To Construct the design principles of central processing and memory Units.
3. To function the parallelism, GPU architectures and contemporary processor design

Course Outcomes:

1. Understand data representation and micro-operations, design of the computer.
2. Apply the instruction set for problems with the design of the central processing unit.
3. Choose the various operations for computer arithmetic metrics.
4. Design the cache memory and virtual memory for the performance enhancement of the CPU.
5. Examine the functionalities of parallelism, contemporary architectures, and the GPU.

Module:1	**Data Representation and Microoperations**	**6 hours**

Introduction to number system, Binary, Hexa, Octal Addition, Subtraction, Multiplication, Division. Basic logic gates, Universal logic gates, Flip-flops and Types, Combinational logic circuits.

Module:2	**Basic Computer Organization and Design**	**6 hours**

Evolution of Computer Architecture- Basic computer organization and design - Registers- Instruction set - Timing and Control - Instruction cycle - Memory Reference Instructions- Input - Output Interrupt - Design of the basic computer.

Module:3	**Design of the Central Processing Unit**	**7 hours**

Central processing unit- Instruction format and Types - Addressing modes - Stack operation - Program Status word - Data Transfer operations - RISC and CISC processors and their differences

Module:4	**Computer Arithmetic**	**6 hours**

Computer Algorithms, Signed and unsigned addition, Booth's Multiplication algorithm, Restoring and non-restoring division, Decimal and Floating-point arithmetic operations.

Module:5	**Memory organization and Design**	**6 hours**

Memory Types, RAM and ROM, Auxiliary memories, Cache memory organization and architecture-Types and numerical problems.

Module:6	**I/O Device Interfacing**	**6 hours**

Input Output: Input-Output Organization Peripheral devices I/O Interface Isolated I/O and Memory mapped I/O, Asynchronous Data Transfer Strobe and handshaking methods

Module:7	**Data-Level Parallelism in Vector, SIMD, and GPU Architectures**	**6 hours**

The Development of SIMD Supercomputers, Vector Computers, Multimedia SIMD Instruction Extensions, and Graphical Processor Units, types and architectures.

Module:8	**Contemporary issues:**	**2 hours**

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	**45 hours**
	Total Tutorial hours:	**15 hours**

Text Book(s)

1	Morris Mano, Rajib Mall, "Computer System Architecture", 2020, Fourth Edition, Pearson Publication.
2	Hennessy, J. L., Patterson, D. A, "Computer Architecture: A Quantitative Approach. Amsterdam", 2017, Sixth edition, Morgan Kaufmann.

Reference Books

1	Stallings, W., "Computer Organization and Architecture", 2021, Pearson Education.
2	Govindarajalu, B, "Computer Architecture and organization: Design principles and applications", 2010, Tata McGraw-Hill.

Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar / group discussion / field work

Recommended by Board of Studies	30-05-2023		
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Course Code	Course Title	L	T	P	C
UCSC104L	Data Structures and Algorithms	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand and apply suitable data structures in all possible applications
2. To develop and design algorithms using the data structures concept
3. To analyze the efficiency of algorithms developed

Course Outcomes:

1. Understand the basic concepts of data structures and algorithms
2. Derive the efficiency of algorithms
3. Choose appropriate linear and non-linear data structures to develop any application
4. Apply the suitable sorting and searching algorithms in real world applications
5. Create effective solution for challenging real world problems

Module:1	**Introduction to Data Structures and Algorithms**	**7 hours**
Arrays - Structures - Pointers - Data structures and its types - Abstract Data Type - Algorithms - Asymptotic notations - Time complexity analysis - Algorithm efficiency		
Module:2	**Stacks**	**6 hours**
Introduction - Array implementation of stack operations – Balancing symbols - Infix to Postfix conversion - Infix to Prefix conversion - Evaluation of Postfix expression - Evaluation of Prefix expression		
Module:3	**Queues**	**5 hours**
Introduction - Types of Queues - Array implementation of Linear Queue operations - Circular Queue and its implementation - Applications of Queue		
Module:4	**Lists**	**6 hours**
Array implementation of List operations - Linked list and its types - Singly Linked list operations - Linked list implementation of Stack - Linked list implementation of Queue		
Module:5	**Trees**	**7 hours**
Basic Terminologies - Binary tree construction from General trees - Binary Tree representation - Expression Trees - Binary Tree Traversals - Binary Search Tree and its operations		
Module:6	**Graphs**	**6 hours**
Basic Terminologies - Graph representation - Graph Traversals - Topological sorting - Dijkstra's Algorithm		
Module:7	**Sorting and Searching**	**6 hours**
Bubble sort - Selection sort - Insertion sort - Shell sort - Radix sort - Quick sort - Heap sort - Merge sort - Linear search - Binary search		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 2017, Fifth Edition, Career Monk.

Reference Books

1.	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 2019, Fourth Edition, Pearson.
2.	Ellis Horowitz, SartajSahni and Anderson, "Fundamentals of Data Structure in C", 2008, Second Edition, University Press.
3.	ReemaThareja, "Data Structures using C", 2017, Second Edition, Oxford Universities Press.

Mode of Evaluation: CAT, Written Assignment, Quiz, and FAT.

Recommended by Board of Studies	30-05-2023

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Course Code	Course Title	L	T	P	C
UCSC104P	Data Structures and Algorithms Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand and apply suitable data structures in all possible applications.
2. To develop and design algorithms using the data structures concept.

Course Outcomes:

1. Choose appropriate linear and non-linear data structures to develop any application.
2. Apply the suitable sorting and searching algorithms in real world applications.
3. Create effective solution for challenging real world problems.

	Indicative Experiments	Hours
1.	Arrays and Structures.	3 Hours
2.	Stack operations using arrays and its applications.	6 Hours
3.	Queue and Circular queue operations using arrays.	2 Hours
4.	List operations using arrays, Linked List operations, Stack using linked list and Queue using linked list.	4 Hours
5.	Creation of Binary Search Tree, implementation of its operations and Traversing it.	3 Hours
6.	Graph Traversals.	2 Hours
7.	Implementation of sorting algorithms.	8 Hours
8.	Implementation of searching algorithms.	2 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1. Narasimha Karumanchi, “Data Structures and Algorithms Made Easy”, 2017, Fifth Edition, Career Monk.
2. Reema Thareja, “Data Structures using C”, 2014, Oxford Universities Press, Second Edition.

Mode of assessment: CAT, Exercises, FAT

Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Course Code	Course Title	L	T	P	C
UCSC105L	Object Oriented Programming	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To learn the fundamentals of object oriented programming concepts and methodologies
2. To code, document, test, and implement a well-structured, robust computer program and reusable modules

Course Outcomes:

1. Understand the principles of object oriented programming, input and output stream
2. Identify and distinguish control structures between sequential, repetition and selection statements
3. Declare and manipulate arrays, pointers, and dynamic memory allocation
4. Apply Object Oriented Design and Programming concepts using encapsulation, inheritance, polymorphism and exception handling
5. Develop effective programs using virtual functions, file handling and pointer concepts.

Module:1	**Principles of Object-Oriented Programming**	**5 hours**

Object-Oriented Programming (OOPs) Paradigm, Basics of Object-Oriented programming, Application of OOP

Module:2	**Tokens, Expressions and Control Structures**	**5 hours**

Keyword, Identifiers, User defined data types, Derived data type, Constant, Operators , Scope resolution operator, Memory Management operators, Expression and their types, Operator Precedence, Control Structures

Module:3	**Classes and objects**	**6 hours**

Introduction, Class creation, Access modifiers, Defining member functions, Nested class, static data member, arrays within class, array of object, this pointer.

Module:4	**Constructors, Destructors & Exception Handling**	**7 hours**

Constructor Types, Destructor, Basics of Exception Handling, Exception Handling Mechanism-throw and catch mechanisms

Module:5	**Polymorphism**	**7 hours**

Overloading-Function overloading, Operator overloading- Binary, unary Insertion, Extraction operator

Module:6	**Inheritance: Extending Classes**	**7 hours**

Inheritance- Base class, Derived class, Types of inheritance-Single, Multiple, Multilevel, Hybrid, Hierarchical, Diamond problem

Module:7	**Pointers, Virtual Functions & File handling**	**6 hours**

Pointers, Pointers to objects, Pointer to derived class, Virtual Functions, Pure virtual Functions, Classes for file stream operation, Opening and closing a file, detecting End-of-file, reading and writing a file.

Module:8	**Contemporary Issues**	**2 hours**

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	**45 hours**

Text Book(s)

1. E.Balagurusamy, ”Object Oriented Programming with C++”, 2020, Eighth Edition,TataMcGrawHill.

Reference Books

1. Herbert Schiidt,”C++: The Complete Reference”,2017, Fourth Edition, McGraw Hill.
2. Stanely Lippman and Josee Lajoie , “C++ Primer”, 2012, Fifth Edition, Addison-Wesely.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	30-05-2023

Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Course Code	Course Title	L	T	P	C
UCSC105P	Object Oriented Programming Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v. 1.0			

Course Objectives:

1. To understand and implement object oriented concepts
2. To strengthen problem solving ability by using the characteristics of an object-oriented approach
3. To design real time applications using object oriented features

Course Outcomes:

1. Demonstrate class, object, inheritance and polymorphism.
2. Implement function and operator overloading.
3. Construct generic classes using template concepts.

	Indicative Experiments	**Hours**
1.	i. Write a program that reads in a month number and outputs the month name. ii. Write a program to reverse the digits of a given number. iii. Write a program to convert an amount in figures to equivalent amount in words. a. Convert an amount (in millions) to equivalent amount in words b. Convert an amount (in billions) to equivalent amount in words iv. Write a program to input 20 arbitrary numbers in one dimensional array. Calculate the frequency of each number. Print the number and its frequency in a tabular form.	5 Hours
2.	i. Write a program to define class complex having two data members viz real and imaginary part. ii. Write a program to define class Person having multiple data members for storing the different details of person e.g. name, age, address, height.	5 Hours
3.	Assume that XYZ Bank allows to open an account with an initial amount of Rs.5000 and you can add some more amount to it. Create a class 'AddAmount' with a data member named 'amount' with an initial value of Rs.5000. Now make two constructors of this class as follows: ● AddAmount()- without any parameter - no amount will be added to the XYZ Bank account ● AddAmount(int n) - having a parameter which is the amount that will be added to the XYZ Bank account Write a program to create an object of the 'AddAmount' class, call these two constructors and display the final amount in the XYZ Bank.	5 Hours
4.	In an organization in computation of its performance and which directly helps in calculating their salary. Assume the Basic Salary is 10000 and if an employee achieved sales of 100 percent of target the employee is provided with 100 percent of basic pay as performance incentive, if the employee achieved 75 percent and above as sales target, he/she gets 50 percent of basic pay as performance incentive and if the employee achieves less than 75 percent, he/she gets only ten percent as performance incentive. Write a program using inheritance and abstract class to compute the salary of employees.	5 Hours
5.	Write a program to create parent class Shape, derive Triangle, Square and Circle from the Shape class, and then calculate area of these shapes using pure virtual function.	5 Hours
6.	Write a program to create a simple calculator which can add, subtract, multiply and divide two numbers using function template.	5 Hours
	Total Laboratory Hours	**30Hours**

Text Book(s)			
1	E.Balagurusamy, “Object Oriented Programming with C++”, 2020, Eighth Edition, Tata McGrawHill.		
Reference Books			
1	Behrouz A. Forouzan and Richard F. Gilberg, “C++ Programming An Object - Oriented Approach”, 2022, First Edition, McGraw Hill		
2	Kanetkar, A., “101 Challenges in C++ Programming”, 2017, BPB Publications.		
Mode of assessment: Continuous assessment / FAT / Oral examination and others.			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Course Code	Course Title	L	T	P	C
UCSC201L	Operating Systems	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand different types and structures of operating systems designed for mobile, desktop and high-performance computing servers
2.To identify the core functionalities of operating systems such as process management, memory management and file system management
3. To analyze core functionalities of operating system to cater the need of end users and services effectively

Course Outcomes:

1.Understand the services and functionalities of operating system with process and thread creation mechanism
2. Explore the synchronization mechanism and providing solutions to critical sections
3. Apply various process scheduling algorithm to improve CPU utilization and throughput.
4. Categorize various physical/virtual memory management techniques to optimize memory allocation to processes
5. Inspect the various disk scheduling algorithms and file system management approaches

Module: 1	**Operating system structure and Organization**	**7 hours**
Computer-System Organization- Architecture - Structure and operations of Operating System - Services - Interface between user and operating system -System Calls -System Boot		
Module:2	**Process and Thread Management**	**6 hours**
Process states -context switching-process control bloc – scheduling - Operations on Processes - Inter-process Communication - Threads Overview, Multithreading Models		
Module:3	**Process synchronization**	**7 hours**
Race Condition - Critical section problem, Peterson's Solution, Mutex Locks, Semaphores, Classic Problems of Synchronization- Producer-Consumer problem, Readers-writer problem, Dining Philosopher's problem		
Module:4	**CPU Scheduling and Deadlock**	**7 hours**
Scheduling Algorithms - Pre-emptive and Non-Pre-emptive scheduling -Deadlocks- System Model, Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance		
Module:5	**Main Memory Management**	**6 hours**
Swapping- Contiguous Memory Allocation - First Fit, Best Fit, Worst Fit- Segmentation- Paging		
Module:6	**Virtual Memory**	**4 hours**
Demand Paging -Page Fault - FIFO, LRU, OPR Page Replacement Algorithms, -Allocation of Frames –Thrashing		
Module:7	**Storage Management**	**6 hours**
File-System Interface- File Concept, File-System Mounting, Allocation Methods, Disk structure, Disk Scheduling Algorithms		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	A.Silberschatz, P.B. Galvin & G. Gagne,"Operating system concepts", 2018, Tenth Edition, John Wiley.

Reference Books

1	W. Stallings,"Operating systems-Internals and Design Principles", 2018, Ninth Edition, Prentice-Hall.
2	Tanenbaum , "Modern Operating Systems", 2022,Fifth Edition, PrenticeHall.

Mode of Evaluation: CAT / written assignment / Quiz / FAT			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
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CHENNAI

Course Code	Course Title	L	T	P	C
UCSC201P	Operating Systems lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand operating system concepts such as scheduling, deadlock management, file management and memory management
2. Develop and implement C programs using Unix system calls

Course Outcomes:

1. Experiment with Unix commands and shell programming
2. Analyze process management and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority, Deadlock management
3. Evaluate memory management schemes and page replacement schemes
4. Interpret different file allocation methods and disk scheduling algorithms

	Indicative Experiments	Hours
1.	**Basic Unix, Shell commands** Unix commands - shell commands	4 Hours
2.	**Process Management Concepts** Process creation – Parent process – child process	4 Hours
3.	**Multi-Threads Concept** Thread creation - Execute a process and kernel	4 Hours
4.	**CPU Scheduling Concepts** FCFS - Round Robin- SJF -Priority Scheduling	4 hours
5.	**Deadlocks and Synchronization Concept** Dead Lock prevention - Dead Lock Detection	4 Hours
6.	**Memory and Virtual Memory Concepts** Memory Allocation methods - Page Replacement Algorithm	6 Hours
7.	**File management Concepts** Disk scheduling Algorithms - File Allocation	4 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Abraham Silberschatz, Greg Gagne, Peter B. Galvin, “Operating System Concepts”, 2020, Tenth Edition, Wiley.

Reference Books

1.	Andrew S. Tanenbaum, “Modern Operating Systems”, 2016, Fourth Edition, Pearson.
2.	William Stallings, “Operating Systems: Internals and Design Principles”, 2021, Pearson, Ninth Edition.

Mode of assessment: Continuous assessment / FAT / Exercises			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Course Code	Course Title	L	T	P	C
UCSC202L	Database Management Systems	3	0	0	3
Prerequisite					**Syllabus version**
					v.1.0

Course Objectives:

1. To understand the basics of database management systems (DBMS), with an emphasis on how to organize, maintain and retrieve efficiently, and effectively the information from a DBMS
2. To examine the fundamental concepts of the relational model, including relations, attributes, domains, keys, foreign keys, entity integrity and referential integrity
3. To inspect the basic issues of transaction processing, concurrency control and database security

Course Outcomes:

1. Identify the basic concepts of database and various data models used in DB design
2. Design conceptual models to represent simple database application scenarios
3. Construct high-level conceptual model to relational data model and to improve a database design by normalization
4. Develop a query database using SQL and PL/SQL and Implementing the database using PL/SQL Statements
5. Elaborate the concepts of transaction and security control in data base

Module:1	**Introduction to Database**	**6 hours**
Introduction to Database – Characteristics - Application of Database Systems - Data Models ,Data Abstraction ,Instance and Schemas ,Three Schema Architecture - Database Languages - User Interfaces – Database Architecture - Classification		
Module:2	**Data Modeling using E-R Model**	**6 hours**
High-Level Conceptual Data Models for Database Design - Entity Types - Entity Sets - Attributes and Keys - Relationship Types - Relationship Sets - Roles and Structural Constraints - Weak Entity Types - ER Diagrams		
Module:3	**Relational Data Model**	**6 hours**
Relational Model Constraints - Update Operations - Dealing with Constraint Violations - Database Design Using ER – to - Relational Mapping		
Module:4	**SQL**	**7 hours**
Data Definition and Data Types - Constraints in SQL - Basic Queries – SQL Functions, Aggregate Functions – SET Operations - Complex Queries – Views		
Module:5	**PL/SQL**	**6 hours**
PL/SQL Block – Data Types - Control Structure – Function – Procedure – Cursors – Exception Handling – Trigger		
Module:6	**Relational Database Design**	**6 hours**
Informal Design Guidelines for Relation Schemas – Data Anomalies - Functional Dependencies - Inference Rules - Normal Forms – 1NF, 2NF, 3NF and BCNF – Properties of Relational Decompositions – Algorithms		
Module:7	**Transaction Processing & Security**	**6 hours**
Introduction - Desirable Properties of Transactions – Schedules – Transactions support in SQL – Need for Concurrency Control and Recovery – Database Security - Discretionary Access Control Based on Granting and Revoking Privileges		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, “Database System Concepts”, 2020, Seventh Edition, McGraw Hill.

Reference Books				
1.	Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, 2007, Third Edition, McGraw Hill.			
2.	RamezElmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, 2016, Seventh Edition, Pearson.			
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar				
Recommended by Board of Studies	30-05-2023			
Approved by Academic Council	No. 70	Date	24.06.2023	

Course Code	Course Title	L	T	P	C
UCSC202P	Database Management Systems Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand, analyze and design databases
2. To examine the existing database system, and create new relational database and analyze the design.

Course Outcomes:

1. Apply SQL interface of a RDBMS package to create, secure, populate and query of Database
2. Formulate query using SQL, solutions to a usage of query and data update problem
3. Utilize procedural language to develop comprehensive solutions for all type of applications

	Indicative Experiments	Hours
1.	**Database creation** Creating Tables - Viewing all Tables in a Database - Dropping / Truncating/Renaming Tables.	2 Hours
2	**Schema Refinement** Changing structure of the existing table using Alter command - Assigning constraints - drop the constraints/modify constraints.	2 Hours
3.	Schema Design using Tools (ER and Relation Model)	2 Hours
4.	**Database manipulation** Inserting / Updating / Deleting Records in a Table – View the table using Select - Transaction control commands – commit, rollback and save point	4 Hours
5.	**For a given set of relation schemes, perform the following** Simple Queries - Simple Queries with Aggregate functions - group by and having clause.	4 Hours
6.	**SET Operators and Built-in Functions** Union, Intersection, Minus, and Queries involving Date Functions - String Functions and Math Functions	4 Hours
7.	**Complex Queries (Nested and Join Queries)** Join Queries-Inner Join, Outer Join - Subqueries-With IN clause	4 Hours
8.	**PL/SQL Programs** Sample program using loops - Conditionals – Exception Handling	4 Hours
9	**PL/SQL– Block** Cursor, Procedure, and Functions	2 Hours
10.	**PL/SQL –** Trigger	2 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1. Bob Bryla, Kevin Loney, “Oracle Database 12c The Complete Reference”, 2013, Illustrated Edition, McGraw-Hill.
2. Steven Feuerstein, Bill Pribyl, “Oracle PL/SQL Programming”, 2018, Sixth Edition, O'Reilly.

Mode of assessment: CAT, Exercises, FAT

Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Course Code	Course Title	L	T	P	C
UCSC203L	Computer Networks	3	0	0	3
Pre-requisite		**Syllabus Version**			
		v 1.0			

Course Objectives:

1. To understand the basic terms and concepts of network models and functions of different layers
2. To analyze the design and performance matters allied with the network and data link layers.
3. To evaluate the IP addressing and the necessities of transport and application layer protocols

Course Outcomes:

1. Understand the fundamental concepts of network models
2. Analyze the internetworking devices
3. Evaluate the function of Data Link layer and Medium Access Control
4. Construct the network with an IP address and identify the shortest path, transport layer protocols and congestion control algorithms
5. Inspect the rudiments of Application Layer Protocol and network security

Module:1	**Layered Network Architecture**	**6 hours**
Evolution of data Networks – Network Topologies –Switching Techniques – Multiplexing – Types of network – ISO/OSI Reference Model – TCP/IP Model – Addressing – Network performance metrics		
Module:2	**Internetworking devices**	**5 hours**
Repeaters – Hubs – Bridges -Transparent and Source Routing- Spanning tree algorithm- Layer -2 Switches – Layer -3 Switches /Routers		
Module:3	**Data Link Layer- Logical Link Control**	**6 hours**
Error Detection Techniques – Parity-Cyclic Redundancy Check - Checksum-Automatic Repeat Request protocols: Stop and wait, Go back-n and Selective Repeat – Framing		
Module:4	**Medium Access Control and LAN technologies**	**8 hours**
Scheduling approaches to MAC - Random access Protocols – Carrier Sense Multiple Access- Ethernet-Wireless LAN- Bluetooth		
Module:5	**Network Layer**	**8 hours**
Internetworking – IP Addressing – Subnetting – IPv4 and IPv6– Routing – Distance Vector and Link State Routing – Routing Protocols		
Module:6	**Transport Layer**	**5 hours**
Connection oriented and Connectionless Service – User Datagram Protocol – Transmission Control Protocol – Congestion Control – Quality of Service parameters		
Module:7	**Application Layer**	**5 hours**
Domain Name System – Simple Mail Transfer Protocol – File Transfer Protocol – Hypertext Transfer Protocol; Introduction to Network Security and Cryptography		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Behrouz A Forouzan, “Data Communications and Networking”, 2017, Fifth Edition, Tata McGraw-Hill.

Reference Books

1.	Dimitri P. Bertsekas & Robert Gallager, “Data Networks”, 2013, Second Edition, Prentice Hall.
2.	W. Stallings, “Data and Computer Communications”, 2017, Tenth Edition, Pearson Prentice Hall.
3.	Alberto Leon-Garcia, “Communication Networks”, 2017, Second Edition, Tata McGraw-Hill.

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test

Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

urse Code	Course Title	L	T	P	C

Vellore Institute of Technology
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CHENNAI

UCSC203P	Computer Networks Lab	0	0	2	1
Prerequisite		**Syllabus Version**			
		v.1.0			

Course Objectives:

1. To understand the basic terms and concepts of network models and functions of different layers
2. To analyze the design and performance matters allied with the network and data link layers.
3. To examine the IP addressing and the necessities of transport and application layer protocols

Course Outcomes:

1. Understand the functioning of internetworking devices and network topologies utilizing simulation tools
2. Inspect the performance of error detection and medium access control protocols utilizing simulation tools
3. Analyze the routing algorithms and transport layer protocols utilizing simulation tools

Indicative Experiments

1	Study of basic network commands and demonstrate the functionalities of all network devices via simulator	4 hours
2	Analyze the spanning tree algorithm by varying the priority among the switches	4 hours
3	Simulation of framing and error detection schemes. Simulation of different Medium Access Control and flow control schemes	4 hours
4	Examine the network: ● Identify Connectivity Problems- Use the ping command to test network connectivity. ● Router configuration ● Troubleshoot Network Connections router. ● Examine the router to find possible configuration errors. ● Use the necessary commands to correct the router configuration. ● Verify the logical configuration. ● Begin troubleshooting at the host connected to the router. ● Examine the router to find possible configuration errors. ● Use the necessary commands to correct the router configuration. ● Verify the logical configuration.	4 hours
5	Implementation of various routing algorithms to compute the shortest path	4 hours
6	Simulation of congestion control algorithms	4 hours
7	Developing simple applications using TCP and UDP socket programming	6 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1	Behrouz A Forouzan, “Data Communications and Networking”, 2017, Fifth Edition, Tata McGraw-Hill.
2	Alberto Leon-Garcia, “Communication Networks”, 2017, Second Edition, Tata McGraw-Hill.

Mode of Assessment: Continuous Assessment and Final Assessment Test			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
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CHENNAI

Course Code	Course Title	L	T	P	C
UCSC204L	Programming in Java	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To apply the core Java fundamentals to learn the concepts in J2SE
2. To handle exceptions and create multithreaded applications, dynamic and interactive graphical applications using JavaFX
3. To apply the concept of file handling, data framework and databases connectivity to solve the problems

Course Outcomes:

1. Provide a basic understanding and solving the computational problems using Java programming
2. Handle object oriented concepts and run-time errors
3. Execute collection framework, multi-processes using threads and handle files
4. Design interactive GUI applications using JavaFX
5. Create database programs to perform CRUD operations

Module:1	**Introduction to Java Programming**	**3 hours**
Overview of Java programming language, History of Java programming language. Java environment setup – JVM- Javadoc – Structure of a Java program-Features of Java programming language-Variables and its Scope -Keywords-Data Types- Identifiers – Operators – Precedence – Command line arguments – final - Simple computational problems		
Module:2	**Conditionals, Looping, Arrays, and Strings**	**6 hours**
Decision-making statements - Looping statements - Jump statements - Arrays in Java-1D and 2D arrays –Strings		
Module:3	**Object Oriented Programming concepts in Java**	**7 hours**
Classes- Objects- Constructors- Inheritance- Interfaces- Polymorphism- abstract class-Garbage collection-finalize() method		
Module:4	**Packages and Exception Handling in Java**	**7 hours**
User-defined packages, Inner classes. Exception vs Error, Purpose of Exception handling-Try, throw, throws, finally with different cases and catch statements-Predefined exception handling classes- user-defined exception handling-Thread life cycle-Creating multi-threads and synchronization		
Module:5	**Threads, File handling and Collection**	**6 hours**
Thread life cycle-Creating multi-threads and synchronization - I/O basics - Reading Console Input - Writing Console output - Reading and Writing files - Generic class and methods-Collections framework-List, set, and map interface		
Module:6	**GUI and Java Streams**	**7 hours**
Creating the GUI Components using JavaFX - Different types of Layouts - Event handling - java streams interface - java stream operations		
Module:7	**Database connectivity in Java using JDBC**	**7 hours**
JDBC architecture, establishing connectivity and working with connection interface, working with statements, Creating and executing SQL statements, Working with Result Set. Accessing databases and performing CRUD operations using Java		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Herbert Schildt, “The Complete Reference-Java”, 2017, Eleventh Edition, Tata Mcgraw-Hill.			
Reference Books				
1.	Cay S. Horstman, “Core Java Volume-1, Fundamentals”,2020, Eleventh Edition, Oracle Press.			
2.	Nicholas S. Williams, “Professional Java for Web Applications”, 2014, first edition, Wrox Press.			
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar				
Recommended by Board of Studies		30-05-2023		
Approved by Academic Council		No. 70	Date	24.06.2023

Course Code	Course Title	L	T	P	C
UCSC204P	Programming in Java Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To apply the core Java fundamentals to learn the concepts in J2SE
2. To handle exceptions and create multithreaded applications, dynamic and interactive graphical applications using JavaFX
3. To apply the concept of file handling, data framework and databases connectivity to solve the problems

Course Outcomes:

1. Provide a basic understanding and solving the computational problems, Handle run-time errors
2. Execute collection framework, multi-processes using threads and handle files
3. Design interactive GUI applications, database programs

Indicative Experiments		
1.	Operators- Datatypes-Keywords-Reading different values from the user-Solving Simple Computational Problems	**3 Hours**
2.	Decision-making statements (if-else, switch-case)- Looping statements (while, do-while, for and enhanced for loop)- Jump statements (break, continue, return)	**3 Hours**
3.	Arrays – Classes – Objects - String class - Constructors	**3 Hours**
4.	Inheritance- Polymorphism-abstract class	**3 Hours**
5.	User-defined packages and Interfaces	**3 Hours**
6.	Exception handling-Predefined exception handling classes- user-defined exception handling	**3 Hours**
7.	File handling in Java	**3 Hours**
8.	Generic class and methods-Collections framework-List, set and map interface	**3 Hours**
9.	Creating the GUI Components using JavaFX, Java Streams and event handling	**3 Hours**
10.	Database - CRUD operations	**3 Hours**
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Herbert Schildt,"The Complete Reference-Java", 2017, Eleventh Edition, Tata Mcgraw-Hill.

Reference Books

1.	Cay S. Horstman, "Core Java Volume-1, Fundamentals", 2020, Eleventh Edition, Oracle Press.
2	Nicholas S. Williams, "Professional Java for Web Applications", 2014, First Edition, Wrox Press.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
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CHENNAI

Course Code	Course Title	L	T	P	C
UCSC205L	Web Development	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To acquire the skills and knowledge necessary to create websites and online applications
2. To understand the fundamental design principles, data, products, and services for websites based on client server technologies
3. To explore and use key programming concepts to build a dynamic website using PHP

Course Outcomes:

1. Understand the fundamentals of HTML webpage design and learn how to build a website
2. Design websites using properly formatted HTML and the appropriate CSS layout/styling pattern
3. Apply the concept of JavaScript to create highly responsive interfaces that enhance user experience and provide dynamic functionality
4. Integrate DOM to improve website functionality and establish a standard programming interface
5. Develop a dynamic and interactive webpage using PHP and databases

Module-1	Web Basics	5 hours

WWW–Sticking with the standards-The Internet Versus the Web-The Anatomy of a Web Page-Creating Web Content- Understanding Web Content Delivery-Selecting a Web Hosting Provider-Testing with Multiple Web Browsers-The Request/Response Procedure–Content strategy-Testing Web Content **-** Responsive Web Design

Module-2	HTML 5	6 hours

Creating a Simple page-HTML Document Structure-Marking Up Text-Paragraphs-Headings-Thematic Breaks-Lists-Organizing Page Content-Adding Links-Adding Images-Table Markup-Forms-Working with Fonts, Text Blocks, and Lists-Using Tables to Display Information-Using External and Internal Links-Working with Colors, Images, and Multimedia

Module-3	Cascading Style Sheets	8 hours

Introduction-The Benefits of CSS– Internal Style Sheets and Inline Style Sheets–More CSS Techniques-Styling Forms-Styling Tables-Image Replacement Techniques–Formatting Text- Colors and Backgrounds-Placing List Item Indicators-Creating Image Maps with List Items – The CSS Box Model-Margin, Border, Padding – Creating Vertical Navigation with CSS- Creating Horizontal Navigation with CSS

Module-4	JavaScript Basics	6 hours

Understanding JavaScript- Exploring JavaScript's Capabilities –Using Variables–Understanding Expressions and Operators- Data types- Converting Between Data Types-Using String Objects-Working with Substrings-Using Numeric Arrays and String Arrays-Sorting a Numeric Array-Using Functions-Using Objects to Simplify Scripting-Controlling Flow with Conditions and Loops

Module-5	JavaScript DOM and Event Handling	6 hours

Understanding the Document Object Model (DOM) -Using window Objects-Working with the document Object-Accessing Browser History-Working with the location Object -More About the DOM Structure - Working with DOM Nodes- Creating Positionable Elements-Hiding and Showing Objects-Modifying Text Within a Page--Adding Text to a Page - Responding to Events – Cookies – Validating User Input with JavaScript Regular Expressions

Module-6	PHP Basics	6 hours

The Structure of PHP–Basic Syntax-Variables-Operators-Variable Assignment-Multiple-Line Commands-Variable Typing-Constants-Predefined Constants-The Difference Between the echo and print Commands-Variable Scope- Expressions and Control Flow in PHP-Functions and Arrays

Module-7	PHP Advanced Concepts with Database	6 hours

File Handling-Form Handling – Uploading Files– Sending E-mail- Generating Images- Cookies and Sessions in PHP- MySQL Basics- Summary of Database Terms-Accessing MySQL via the Command Line-Using the Command-Line Interface-MySQL Commands-Designing and Creating Web Database-

Working with MySQL- Accessing MySQL Database from the Web with PHP			
Module-8	**Contemporary Topics**		**2 hours**
Guest Lecture from Industry and R & D Organizations			
	Total Lecture hours:		**45 hours**
Text Book(s)			
1	Julie Meloni, Jennifer Kyrnin, “HTML, CSS, and JavaScript All in One: Covering HTML5, CSS3, and ES6”, 2019, Sams.		
2	Robin Nixon, “Learning PHP, MySQL & JavaScript”, 2018, 5th Edition, O'Reilly.		
Reference Books			
1	Jennifer Niederst Robbins, “Learning Web Design: A Beginner`S Guide To HTML, CSS, JavaScript, And Web Graphics”, 2018,Fifth Edition, O’Reilly.		
2	Robin Nixon, “Learning PHP, MySQL & JavaScript: A Step-by-Step Guide to Creating Dynamic Websites”, 2021, Sixth Edition, O’Reilly.		
3	Luke Welling Laura Thomson,2017, “PHP and MySQL Web Development”, Fifth edition, Addison-Wesley.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Course Code	Course Title	L	T	P	C
UCSC205P	Web Development Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

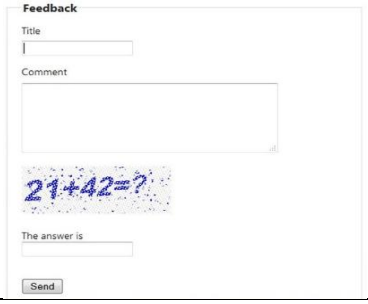
Course Objectives:

1. To understand, analyze and design websites and online applications
2. To explore and use key programming concepts to build a dynamic website using PHP

Course Outcomes:

1. Design websites using properly formatted HTML and the appropriate CSS layout/styling pattern
2. Apply the concept of JavaScript to create highly responsive interfaces that enhance user experience and provide dynamic functionality
3. Develop a dynamic and interactive webpage using PHP and databases

	Indicative Experiments	**Hours**
1.	Program to illustrate Nested ordered list and Definition lists. a. Solid gray banner along the top of the browser window i. Company logo ii. Product image b. A text-based navigation menu i. Links to each of the site's web documents c. A content area i. A heading that identifies page content ii. A paragraph for displaying content iii. A copyright notice	2 Hours
2	Program to illustrate links. A. Create links to five different already created pages. B. Create a page with a link at the top of it that when clicked will jump all the way to the bottom of the page. At the bottom of the page there should be a link to jump back to the top of the page. C. Write an HTML code to create a Home page having three links: About Us, Our Services and Contact Us. Create separate web pages for the three links	2 Hours
3.	Write CSS code to implement the following: (a) Colorize text of a paragraph where RGB value is (51, 204, 0). (b) Place a background image rose.jpeg behind a single word "TEXT" written with a font size of 39 pixels. (c) Place an image in the background of a page such that the image tiles only in the horizontal direction and the starting position is horizontal and vertical center of the page	4 Hours
4.	Create a web page for online book shopping that allows the user to select one or more books by using checkboxes. Display the name of each book and its price. Display the current total in a text box at the bottom of the page. When a book is selected (or unselected), update the total. Use JavaScript to perform any arithmetic operations. Additionally display the book details on mouse hover like author and description of the book. Use CSS to design the webpage	2 Hours
5.	Create an application that allows the user to customize the web page. Your design must include CSS. The application should consist of three files as follows: a. Ask the user to login and read from the database to determine the authentication. If the user is not known, the second file is loaded asking the user to fill up the form to store personal data b. Write a Java script to check the user is known user	4 Hours

	Use cookies for storing the user details and display the username when the user moves on to the next page	
6.	Create a dynamic web page using CSS and JavaScript for admission in an institution. It must consist of the following: a) A page which gives the information about the institution (like course offered, and course duration etc.) b) A page to check for the availability of seats for a program against the JavaScript values. If the seat is available, then an alert should be displayed that the seat is available for the respective course chosen by the user.	4 Hours
7.	A parking garage charges a $2.00 minimum fee to park for up to three hours. The garage charges an additional $0.50 per hour for each hour or part thereof in excess of three hours. The maximum charge for any given 24-hour period is $10.00. Assume that no car parks for longer than 24 hours at a time. Write a script that calculates and displays the parking charges for each customer who parked a car in this garage yesterday. You should input from the user the hours parked for each customer. The program should display the charge for the current customer and should calculate and display the running total of yesterday's receipts. The program should use the function Calculate-Charges to determine the charge for each customer. Use a text input field to obtain the input from the user	4 Hours
8.	Design a HTML form to accept a student register number, name, course (select from the given course list) and the elective subject names he/she is opting for. Write a PHP script to print the student name if he/she has opted for more than four electives	2 Hours
9.	Develop the PHP script to upload image files of size not exceeding 350MB. The code should ensure that there is no duplication of file and on successful upload display the image file extension used and image file name. Write an HTML form to select the file	2 Hours
10	Develop a web page for employee information system with the following details using PHP with MYSQL: i) Create an Employee table containing the details of Empname, Empid [should be unique], Age, Department, Salary per month ii) Store the above data in database using html form. iii) Print the Employees whose name starts with 'sri' iv) Retrieve all the employees whose age is below 50. v) Print the Employees whose salary is between 10k and 20k. vi) Calculate the total salary per year for each employee and display it.	2 Hours
11.	Write a PHP script to generate following contact form with a captcha based on math using GD and authenticate the user through session handling mechanism. 	2 Hours
Total Laboratory Hours		**30 hours**
Text Book(s)		

1	Julie Meloni, Jennifer Kyrnin, “HTML, CSS, and JavaScript All in One: Covering HTML5, CSS3, and ES6”, 2019,Sams.
2	Robin Nixon,“Learning PHP, MySQL & JavaScript: A Step-by-Step Guide to Creating Dynamic Websites”, 2021, sixth Edition, O’Reilly.
Reference Books	
1	Jennifer Niederst Robbins, “A Beginner`S Guide To HTML, CSS, JavaScript, And Web Graphics”, 2018, Fifth Edition, O’Reilly.
2	Luke Welling Laura Thomson, “PHP and MySQL Web Development”, 2017, Fifth edition, Addison-Wesley Professional.
Mode of assessment: CAT, Exercises, FAT	
Recommended by Board of Studies	30-05-2023
Approved by Academic Council	No. 70 Date 24.06.2023

Vellore Institute of Technology
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CHENNAI

Course Code	Course Title	L	T	P	c
UCSC206L	Full Stack Application Development	3	0	0	3
Pre-requisite		Syllabus Version			
		v.1.0			

Course Objectives:

1. To gain an overview of the full stack web application development
2. To build a strong expertise to develop front end application using Bootstrap along with jQuery
3. To design and development of web application using MERN stack

Course Outcomes:

1. Develop responsive web pages using Bootstrap
2. Use JQuery to create dynamic web pages
3. Familiarize the format of data transfer using JSON
4. Develop the server-side business logic to handle client request using NodeJS and MongoDB
5. Build interfaces for web application using open-source JavaScript library ReactJS

Module:1	Essentials of Full Stack Development	6 hours

The Modern Web – Application vs. Websites– Designing systems – System architectures, Identifying concepts, Identifying user interactions, Component Interactions, Tools - Security – Security checklists – Deployment – Twelve factor apps

Module:2	Bootstrap	6 hours

Introduction to Bootstrap – Grid System – Components – Labels – Buttons – Forms – Form elements

Module:3	Dynamic web page design using jQuery	6 hours

Introduction to jQuery –Common jQuery actions and Methods – Understanding the basic behavior of jQuery Scripts – Traversing DOM elements – Creating and Inserting of DOM elements

Module:4	Introduction to JavaScript Object Notation (JSON)	6 hours

Introduction to JavaScript Object Notation (JSON) – Working with JSON – Converting JSON to JavaScript Objects– Converting JavaScript Objects to JSON – Implementing a Simple JSON File and Using the http Service

Module:5	MongoDB	6 hours

MongoDB Basics – Installation, The Mongo Shell – MongoDB CRUD operations – MongoDB Node.js Driver – Reading from MongoDB – Writing to MongoDB

Module:6	Node JS	7 hours

Getting Started with Node.js – Using Events, Listeners, Timers, and Callbacks in Node.js – Handling Data I/O in Node.js – Accessing the File System from Node.js – Implementing HTTP Services in Node.js

Module:7	ReactJS	6 hours

Introduction to ReactJS – React Components - React State – Event Handling - Designing Components – State vs Props – React Router – Simple Routing

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	45 hours

Text Book

1.Front-End Back-End Development with HTML, CSS, JavaScript, jQuery, PHP, and MySQL, 2022, First Edition, Wiley.

2. Vasan Subramanian, “Pro MERN Stack - Full Stack Web App Development with Mongo, Express, React, and Node”, 2017,First edition, Apress.

Reference Books			
1. Chris Northwood,“The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer”, 2018, First Edition, Apress.			
2. Brad Dayley, Brendan Dayley, Caleb Dayley, “Node.js, MongoDB and Angular Web Development”, 2017, Second Edition, Addison-Wesley.			
Mode of Evaluation: CAT, Assignment , Quiz, FAT			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Course Code	Course Title	L	T	P	C
UCSC206P	Full Stack Application Development Lab	0	0	2	1
Pre-requisite		Syllabus version			
		V.1.0			

Course Objectives:

1. To gain an overview of the full stack web application development
2. To build a strong expertise to develop front end application using Bootstrap along with jQuery
3. To design and development of web application using MERN stack

Course Outcomes:

1. Develop responsive web pages using Bootstrap, JQuery to create dynamic web pages
2. Familiarize the format of data transfer using JSON, the server-side business logic to handle client request using NodeJS and MongoDB
3. Build interfaces for web application using open-source JavaScript library ReactJS

S.No	Indicative Experiments	Hours
1.	Develop a simple college web site including all the department information using Bootstrap layout.	4 hours
2.	Design the personal web page like resume format using Bootstrap table and list.	2 hours
3.	Design and validate the following fields of the Registration page using JQuery. a) First Name (Name should contains alphabets and the length should not be less than 6 characters). b) Password (Password should not be less than 6 characters length). c) E-mail id (should not contain any invalid and must follow the standard pattern (name@domain.com) d) Mobile Number (Phone number should contain 10 digits only).	2 hours
4.	Creating and inserting elements using JQuery and DOM.	2 hours
5.	Creating and manipulating JSON objects using JQuery.	4 hours
6.	Create a simple HTTP web server using Node.js to generate a dynamic response.	2 hours
7.	Design web applications with dynamic routing using Node JS, and Express framework	2 hours
8.	Develop a three tier web application model and data manipulations using Node Js, Express, and Mongo DB.	4 hours
9.	Design component-based user interface using ReactJS	4 hours
10.	Develop a simple full stack application for voting system.	4 hours
	Total Laboratory Hours	**30 hours**

Text Book

1.	Chris Northwood “The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer” 2018, First edition, Apress.
2.	Vasan Subramanian “Pro MERN Stack - Full Stack Web App Development with Mongo, Express, React, and Node”, 2017, First edition, Apress.

Reference Books

1.	Front-End Back-End Development with HTML, CSS, JavaScript, jQuery, PHP, and MySQL, 2022, First Edition, Wiley.
2.	Brad Dayley, Brendan Dayley, Caleb Dayley “Node.js, MongoDB and Angular Web Development”, Second Edition, Addison-Wesley.

Mode of Evaluation: CAT, Exercises, FAT			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

VIT®
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CHENNAI

Course Code	Course Title	L	T	P	C
UCSC301L	Software Testing	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand and analyze the software testing fundamentals and its different types of testing
2. To present the knowledge about test management and the overview of the bug and its effect in a project
3. To create and execute the test cases using different testing tools

Course Outcomes:

1. Analyze the problem by using various testing methods and design its test cases
2. Perform unit, integration and system testing
3. Examine and implement various test processes for improving the quality
4. Manage the various test process
5. Test the systems by using recent automation testing tools

Module:1	**Basics of Software Testing**	**5 hours**
Definitions – Test Cases – Software Testing Life Cycle (STLC) – Testing Principles – Fault Taxonomies – Psychology and Economics of Testing – Levels of Testing – Verification and Validation		
Module:2	**Black Box Testing**	**5 hours**
Boundary Value Analysis – Equivalence Class Partitioning –State Based Testing – Decision Table Based Testing – Cause-Effect Graph Testing		
Module:3	**White Box Testing**	**7 hours**
Program Graphs – Code Coverage Testing – Basic Path Testing – Data Flow Based Testing – Slice Testing – Mutation Testing – Graph Matrices – Software Complexity – Cyclomatic Complexity		
Module:4	**Levels of Testing**	**7 hours**
Unit Testing – Integration Testing – System Testing – Acceptance Testing – Debugging –Agile Testing – Regression Testing – Object Oriented Testing – Performance Testing – Web Based Testing – Security Testing		
Module:5	**Static Testing**	**6 hours**
Software Technical Reviews – Roles in Review – Effective Technical Review – Technical Inspections – Inspection Process – Audits – Structured Walkthroughs		
Module:6	**Test Management**	**6 hours**
Test Planning – Test Management – Test Process – Building a Testing Group – The Structure of Testing Group – Testing Activities – Test Progress Monitoring – Test Reporting Test Control		
Module:7	**Test Automation**	**7 hours**
Scope of Automation – Design of Automation – Challenges in Automation – Test Metrics and Measurements. – Test Automation Approach – Testing Frameworks – Recent Trends in Automation		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Paul C. Jorgensen, “Software Testing: A Craftsman’s Approach”, 2021, Fifth Edition, Auerbach Publications..
2.	Sandeep Desai and Srivastava Abhishek, “Software Testing: A Practical Approach”, 2016, Second edition, PHI Learning Publication.

Reference Books

1.	Dorothy Graham, “Foundations of Software Testing”, 2020, Fourth Edition, Cengage Publication.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
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CHENNAI

Course Code	Course Title	L	T	P	C
UCSC301P	Software Testing Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To create test plan and test cases using various testing methods
2. To apply different testing tools to perform black box and white box testing
3. To identify the automation testing tools to test the various applications

Course Outcomes:

1. Design the test cases and create a test plan to improve software quality
2. Generate test cases for software systems using black box and white box testing techniques.
3. Evaluate and test the web-based applications using recent automation testing tools.

	Indicative Experiments	Hours
1.	Design the test cases for any application using manual testing	4 Hours
2	Create test plan for any applications	4 Hours
3.	To perform Regression Testing using RFT tool.	8 Hours
4.	To perform Unit Testing using JUnit testing tool.	4 Hours
5.	To perform load and security testing using Selenium Automation Testing tool.	4 Hours
6.	To Perform performance testing using Apache JMeter testing tool	6 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1	Maurício Aniche, “Effective Software Testing; A developer guide”, 2022, Fourth Edition.
2.	Naresh Chauhan, “Software Testing: Principles and Practices”, 2017, Second Edition, Oxford University Press.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	30-05-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

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CAPSTONE PROJECT

Course Code	Course Title	L	T	P	C
UCSC398J	Project	0	0	0	4
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To provide sufficient hands-on learning experience related to design, development and analysis
2. To develop product and to enhance the technical skills sets in the chosen field

Course Outcomes:

1. Formulate specific problem statements with reasonable assumptions and constraints
2. Perform literature survey for acquiring in-depth knowledge in the chosen domain
3. Design a suitable solution methodology for the problem
4. Conduct experiments, implement and perform analysis
5. Synthesize the results and arrive at scientific conclusions/products
6. Document the result in the form of technical report and presentation

Module Content	(Project duration: One semester)

1. Capstone project may be carried out through theoretical analysis, modeling & simulation, experimentation & analysis, correlation and analysis of data, software development, applied research and any other related activities
2. Project can be 5 months duration based on the completion of required number of credits as per academic regulations
3. Should be team work
4. Carried out inside or outside the university, in any relevant industry or research institution
5. Publications in reputed journals/international conference will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster design

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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DISCIPLINE HONORS COURSES

Vellore Institute of Technology
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CHENNAI

Course Code	Course Title	L	T	P	C
UCSC401L	Design and Analysis of Algorithms	3	0	0	3
Pre-requisite				**Syllabus version**	
				v 1.0	

Course Objectives:

1. To provide mathematical foundations for analyzing the complexity of the algorithms.
2. To impart knowledge on various design strategies that can help in solving real world problems efficiently.
3. To develop efficient algorithms for use in a variety of science and engineering design settings.

Course Outcomes:

1. Analyze the worst-case running times of algorithms using asymptotic analysis.
2. Apply suitable data structures and algorithm design paradigms to solve problems efficiently.
3. Use of searching and sorting in various real-life applications.
4. Apply algorithmic paradigms to various real-world optimisation problems.
5. Explain the hardness of real-world problems with respect to algorithmic design.

Module:1	**Fundamentals of the Analysis of Algorithm Efficiency**	**6 hours**
The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Nonrecursive Algorithms, Mathematical Analysis of Recursive Algorithms		
Module:2	**Brute Force and Exhaustive Search**	**7 hours**
Sorting: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, **Exhaustive Search**: Traveling Salesman Problem, Knapsack Problem.		
Module:3	**Divide and Conquer**	**7 hours**
Sorting Problem: Mergesort, Quicksort, Binary Tree Traversals and Related Properties, Multiplication of Large Integers and Strassen's Matrix Multiplication, The Closest-Pair problem.		
Module:4	**Dynamic Programming**	**7 hours**
Coin-row problem, Change-making problem, Coin-collecting problem, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms.		
Module:5	**Greedy Technique**	**6 hours**
Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes		
Module:6	**Backtracking**	**5 hours**
Backtracking: n-Queens Problem , Hamiltonian Circuit Problem ,Subset-Sum Problem		
Module:7	**Branch-and-Bound**	**5 hours**
Assignment Problem, Knapsack Problem, Traveling Salesman Problem		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Levitin, Anany. "Introduction to the Design and Analysis of Algorithms ."2017, Third Edition, Pearson Education.

Reference Books

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 2019, fourth Edition, Pearson Education, Delhi.
2. Baase, Sara. "Computer algorithms: introduction to design and analysis".2009, Pearson Education India.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
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Vellore Institute of Technology
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CHENNAI

Course Code	Course Title	L	T	P	C
UCSC401P	Design and Analysis of Algorithms lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v 1.0			

Course Objectives:

1. To provide mathematical foundations for analyzing the complexity of the algorithms
2. To impart the knowledge on various design strategies that can help in solving the real world problems effectively.

Course Outcomes:

1. Demonstrate the major algorithm design paradigms
2. Use of searching and sorting in various real-life applications.
3. Implementation of graph algorithms in various real-life applications.
4. Implementation of simple game applications.
5. Apply algorithmic paradigms to various real-world optimisation problems

	Indicative Experiments	Hours
1.	**Brute Force:** Selection Sort, Bubble Sort and Sequential Search	2 hours
2.	Brute-Force: String Matching Exhaustive Search: Knapsack Problem.	2 hours
3.	**Divide and Conquer:** Mergesort, Quicksort	2 hours
4.	**Divide and Conquer:** Multiplication of Large Integers and Strassen's MatrixMultiplication	4 hours
5.	**Dynamic Programming:** Coin-row problem, Change-making problem, Coin-collecting problem	4 hours
6.	**Dynamic Programming:** The Knapsack Problem and Memory Functions	2 hours
7	**Dynamic Programming:** Warshall's and Floyd's Algorithms	4 hours
8	**Greedy Technique:** Prim's Algorithm, Kruskal's Algorithm	2 hours
9	**Greedy Technique:** Dijkstra's Algorithm, Huffman Trees and Codes	4 hours
10	**Backtracking**: *n*-Queens Problem	2 hours
11	**Branch-and-Bound**: Assignment Problem	2 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1. Levitin, Anany. "Introduction to the Design and Analysis of Algorithms", 2017, Third Edition, Pearson Education.

Reference Books

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 2019, Fourth Edition, Pearson Education, Delhi.
2. Baase, Sara. "Computer algorithms: introduction to design and analysis", 2009,Pearson Education India.

Mode of assessment: CAT, Exercises, FAT

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Vellore Institute of Technology
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Course Code	Course Title	L	T	P	C
UCSC402L	**Theory of Computation**	**3**	**1**	**0**	**4**
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To provide an understanding of the basic concepts in theoretical computer science and automation theory.
2. To learn how the compiler works over the phases of lexical analyzer and syntax analyzer.
3. To Design a computational model.

Course Outcomes:

1. Designing all forms of automata according to the conditions.
2. Analyzing languages and validating languages through regular expression.
3. Understanding the need of grammars and formulating the grammars.
4. Analyzing and Designing Turing machines.
5. Undecidable problems and proof of undecidability using Post Correspondence Problems.

Module:1	**Introduction of Theory of Computation**	**3 hours**
Symbols, Alphabets, Strings, Languages, Grammar, Closure representations		
Module:2	**Finite Automata**	**8 hours**
Introduction of Finite Automata, DFA, NFA with null moves, NFA without null moves, Conversion of ε-NFA to NFA without null moves, Conversion of NFA without null moves to DFA, Minimization of DFA, Equivalence of DFA's.		
Module:3	**Regular Expressions and Languages**	**8 hours**
Languages, Languages to Finite Automata, Languages to Regular Expressions, Regular Expressions to Finite Automata, DFA to Regular Expression, Pumping Lemma for Regular language.		
Module:4	**Grammars**	**8 hours**
Context Free Grammar (CFG), Derivations, Parse Tree, Ambiguity in CFG, Simplification of CFG, Normal Forms and types of normal form, CYK Algorithm, Pumping Lemma for Context Free Language (CFL)		
Module:5	**Push Down Automata**	**6 hours**
Introduction to Push Down Automata, Design Deterministic Push Down Automata, Non-Deterministic Push Down Automata.		
Module:6	**Turing Machine**	**6 hours**
Turing Machines (acceptor and transducer), Multi head and Multitape Turing Machines, Universal Language, The Halting problem		
Module:7	**Recursive and Recursively Enumerable Languages**	**4 hours**
Recursive and Recursively Enumerable Languages, Chomsky Hierarchy, Undecidable problems, Post Correspondence Problem		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**
	Total Tutorial hours:	**15 hours**

Text Book(s)

1.	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages, and Computation", 2008, Third edition, Pearson Education

Reference Books

1.	Peter Linz, "An Introduction to Formal Languages and Automata", 2017, Sixth edition, Jones & Bartlett Learning
2.	K. Krithivasan and R. Rama, "Introduction to Formal Languages, Automata and Computation", 2009,

	Pearson Education.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

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Course Code	Course Title	L	T	P	C
UCSC403L	Natural Language Processing	3	1	0	4
Prerequisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To introduce the fundamental concepts and techniques of natural language processing for analyzing text
2. To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach
3. To get acquainted with the algorithmic description of the main language levels to be able to describe briefly the fundamental techniques for processing language

Course Outcomes:

1. Describe major concepts, trends, approaches-systems, and difficulties in Natural Language Processing and the study of language generally
2. Learn Text Preprocessing techniques and Syntax Parsing techniques
3. Understand language modeling and its applications
4. Understand and perform text classification and demonstrate understanding of information retrieval models and ranking algorithms
5. Perform opinion mining and sentiment analysis using various methods

Module:1	**Introduction to NLP**	**5 hours**
Origins of NLP. Language and Knowledge. The Challenges of NLP. Language and Grammar. NLP Applications. Some Successful Early NLP Systems, Ambiguity		
Module:2	**Text Processing**	**7 hours**
Regular Expressions, Text Normalization: Tokenization – Stemming – Lemmatization, Sentence Segmentation, Edit Distance		
Module:3	**N-gram Language Models**	**6 hours**
N-grams - Evaluating Language Models - Sampling sentences from a language model - Generalization and Zeros - Smoothing.		
Module:4	**Text Classification**	**6 hours**
Supervised Text Classification - Naive Bayes, Evaluation: Precision, Recall, F-measure. Avoiding Harms in Classification. Logistic Regression – The sigmoid function - Classification with Logistic Regression. Gradient Descent.		
Module:5	**Parts of Speech and Named Entities**	**6 hours**
Part-of-Speech Tagging. Named Entities and Named Entity Tagging. Markov Models. Hidden Markov Models. HMM Part-of-Speech Tagging		
Module:6	**Semantic Analysis**	**7 hours**
Lexical Semantics- Word Similarity- Word Relatedness- Semantic Frames and Roles- Connotation. Vector Semantics. Words and Vectors- Document Dimensions- Word Dimensions. Cosine for Measuring Similarity. TF-IDF		
Module:7	**Advanced Topics in NLP**	**6 hours**
Machine Translation- Bias and Ethical Issues. Question Answering and Information Retrieval. Chatbots & Dialogue Systems - Properties of Human Conversation. Automatic Speech Recognition and Text-to-Speech.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**
	Total Tutorial hours:	**15 hours**

Text Book(s)

1.	Daniel Jurafsky, James H. and Martin, “Speech and Language Processing”,2023, Third Edition,Pearson.

Reference Books

1.	Siddiqui and Tiwary U.S.,"Natural Language Processing and Information Retrieval",2008, Oxford University.		
2.	Manning, Christopher, and Hinrich Schutze. "Foundations of statistical natural language processing". MIT press, 1999.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

Course Code	Course Title	L	T	P	C
UCSC404L	**High Performance Computing**	**3**	**1**	**0**	**4**
Prerequisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand the modern architecture, data structures, and algorithms for high-performance computing
2. To create fast, powerful, energy-efficient programs that scale to tackle big data
3. To use parallel programming to utilize high-performing heterogeneous resources

Course Outcomes:

1. Appraise modern high performance architectures
2. Investigate the inherent potential and limitations of programs/applications
3. Design parallel programs/applications for multi-core processors
4. Develop parallel programs/applications for distributed systems
5. Examine tools and resources for Exa-scale performance

Module:1	**High Performance Computing (HPC) Architectures**	**6 hours**
Overview of Von-Neumann Architecture, Amdahl's Law, Pipelining, Multi-core, Vector Processing, SMP, GPU and TPU		
Module:2	**Parallel Algorithms**	**8 hours**
Scientific Computing, Fork-Join, Divide and Conquer, Halo Exchange, Permutation, Embarrassingly Parallel Applications, Manager-Worker, and Task Dataflow		
Module:3	**Shared Memory Programming**	**7 hours**
Share Memory Architecture, Coherence Protocols, OpenMP API: Parallel Constructs, Work-sharing Constructs, Synchronization Constructs, Profiling		
Module:4	**Commodity Cluster Programming**	**6 hours**
Commodity clusters, Message Passing Interface (MPI): Data types, Non-Blocking Communication, Collective Communication, Profiling, Overview of Grid and Cloud Technologies		
Module:5	**GPU Programming**	**5 hours**
Coprocessor, GPU: Memory Hierarchy, WARP, CUDA programming: Kernels, Blocks, Threads, Vector processing, Matrix processing, Unified Memory		
Module:6	**Resource Management**	**6 hours**
Resource Job Management System (RJMS), SLURM, Portable Batch System		
Module:7	**Benchmarking**	**6 hours**
Benchmark Suites, Flops, Graph500, GUPS, HPL, MiniApps, TEPS, Top500		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**
	Total Tutorial Hours	**15 hours**

Text Book(s)

1.	Thomas Sterling, Matthew Anderson, Maciej Brodowicz, "High-Performance Computing: Modern Systems and Practices",2018, First Edition, Morgan Kaufmann Publications,

Reference Books

1.	Robert Robey and Yuliana Zamora, "Parallel and High Performance Computing",2021,First Edition, Manning Publication
2.	Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers",2019,Chapman & Hall/CRC Computational Science

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

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Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

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Course Code	Course Title	L	T	P	C
UCSC405L	Optimization Techniques	3	1	0	4
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To acquire basic knowledge about optimization techniques and its importance of decision making.
2. To design linear and nonlinear optimization problems.
3. To choose and apply appropriate optimization method and solve real world problems.

Course Outcomes:

1. Comprehend different types of optimization techniques.
2. Formulate linear programming; maximization and minimization problems
3. Solve problems with single variable and multivariable nonlinear optimization problems.
4. Understand and analyze multi objective optimization problems.
5. Explore the various nature inspired optimization methods

Module:1	**Introduction to Optimization**	**4 hours**
Optimal problem Formulation - Engineering applications of optimization –Optimization techniques		
Module:2	**Linear Programming**	**8 hours**
Formulation of the LPP - Graphical method – Working Procedure – Canonical and standard forms of LPP – Simplex method - Artificial variable techniques - Duality Principle - Dual simplex method		
Module:3	**Single-variable Nonlinear Optimization**	**7 hours**
Classical method for single-variable optimization - Exhaustive search method - Bounding phase method - Fibonacci search method - Golden section search method		
Module:4	**Multivariable Unconstrained Nonlinear optimization**	**6 hours**
Unidirectional search method - Evolutionary search method - Simplex search method – Hook Jeeves pattern search method		
Module:5	**Multivariable Constrained Nonlinear optimization**	**7 hours**
Classical methods for equality constrained optimization – Lagrange Multiplier techniques – Inequality Constrained Optimization - Random search method – Sequential linear programming		
Module:6	**Multi Objective Optimization**	**7 hours**
Global criterion method- Utility function method -Inverted utility method- Bounded objective function method - Lexicographic model – Goal Programming method		
Module:7	**Nature Inspired Optimization**	**4 hours**
Introduction – Genetic Algorithm - Ant Colony Optimization- Particle Swarm Optimization		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R&D Organizations		

Text Book(s)

1. Sukanta Nayak , Fundamentals of Optimization Techniques with algorithms,2020 , Academic Press

Reference Books

1. Michel Bierlaire , Optimization: Principles and Algorithms , 2018, Second Edition, EPFL Press
2. Singiresu S. Rao, Engineering Optimization - Theory and Practice, 2019, Fourth edition John Wiley & Sons, Inc.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 70	Date	24.06.2023

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DISCIPLINE ELECTIVE COURSES

Course Code	Course Title	L	T	P	C
UCCA116L	Organizational Behaviour	3	0	0	3
Pre-requisite			**Syllabus version**		
			V 1.0		

Course Objectives:

1.To provide basic knowledge on the management thoughts pertaining to organizational behaviour
2. To provide basic knowledge on the theories relating to organizational behaviour, for enabling them to function effectively
3. To learn how an organization can be designed and developed to deal with the challenges from environment, technology, and its own processes

Course Outcomes:

1. Develop knowledge about fundamental concepts related to management theories
2. Apply problem- solving skills to resolve the employee's relationship issues
3. Analyze the challenges of employee's relationship problems
4. Demonstrate leadership and team building skills
5. Integrate the knowledge and skills derived from the different functional areas of business

Module: 1	**Organizational Behaviour Introduction**	**3 hours**

Definition - need and importance of organizational behaviour – Nature and scope – Frame work – Organizational behaviour models. Disciplines that contribute to OB field. Challenges and opportunities for OB

Module: 2	**Individual Behaviour**	**7 hours**

Personality – types – Factors influencing personality–Theories– Learning– Types of learners – The learning process – Learning theories Emotions – Emotional Labour–Emotional Intelligence –Theories. Attitudes and Job Satisfaction – Characteristics – Components – Formation –Measurement – Values - Perceptions – Importance – Factors influencing perception – Interpersonal perception– Impression Management

Module: 3	**Motivation Concepts**	**7 hours**

Nature of Motivation - Process of Motivation - Theories of Motivation: Maslow's Hierarchy of Needs Theory, Herzberg's Two Factors Theory, Theory X and Theory Y - McClelland theory of Achievement motivation - Application in industries

Module: 4	**Foundations of Group Behaviour**	**7 hours**

Group dynamics–Emergence of informal leaders and working norms – Group decision making techniques–Team building – Interpersonal relations–Communication–Control. Organizational strategy–Organizational design –Alternative structures–Management process – Authority and organizational control mechanisms Understanding Culture – Strong and Weak Cultures – Types of Cultures – Importance of Culture--Creating and Sustaining Culture – Culture and Strategy

Module: 5	**Leadership and Power**	**6 hours**

Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics

Module:6	**Foundation of Organizational Behaviour**	**6 hours**

High-Performance Teams - Team Structure - Interpersonal Communication - Interpersonal Conflicts & Negotiations

Module:7	**Organizational System**	**7 hours**

Organizational Design – Determinants – Components – Types – Basic Challenges of design – The Role of Strategic Direction in Organization Design–A Framework for selecting Strategy and Design–Differentiation, Integration, Centralization, Decentralization, Standardization, Mutual adjustment–Mechanistic and Organic Structures– Technological and Environmental Impacts on Design– Importance

of Design – Success and Failures in design – Implications for Managers		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Stephen P. Robbins, Timothy A Judge & Neharika Vohra, “Organizational Behavior”, 2022, Eighteenth Edition, Pearson India Education Services Pvt Ltd
Reference Books	
1.	Steven L McShane, Mary Ann Von Glinow and Himanshu Rai, “Organizational Behaviour”, 2022, McGraw Hill
2.	Aswathappa k, “Organisational Behaviour”, 2016, Twelfth Revised Edition, Himalaya Publishing House
3.	Dr.Christopher P. Neck, Jeffery D. Houghton and Emma L. Murray, “Organizational Behavior: A Skill-Building Approach”, 2019,Second Edition, SAGE Publications Inc

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
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Course Code	Course Title	L	T	P	C
UCSC207L	Visual Programming	3	0	0	3
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To learn programming constructs in .NET
2. To solve object oriented and GUI programming in .NET
3. To understand and apply disconnected architecture of .NET

Course Outcomes:

1. Explore features of .NET and VB. NET
2. Analyze and solve GUI based applications using VB.NET
3. Comprehend and apply Object Oriented applications using VB.NET
4. Develop web applications using ASP.NET
5. Understand and solve database applications using ADO.NET

Module:1	**Introduction to .NET**	**4 hours**
Introduction to .Net - Data Types and Expressions – Debugging -Exception Handling - Code Refactoring		
Module:2	**Object Oriented Programming in VB.NET**	**7 hours**
Class Fundamentals – Organizing types with names – modules- Structures and Enumeration – Inheritance – Interface - Delegates and Events – Manipulating files and streams – Namespace		
Module:3	**GUI Programming**	**7 hours**
The Solution explorer – The Toolbox – Properties – The Start page -Windows Layout -The Editor Space – Code Editor -Code Navigation		
Module:4	**Server Explorer, Project and Item Templates**	**4 hours**
Server Connections – Data Connections – SharePoint Connections – Creating Templates – Extending Templates – Starter kits		
Module:5	**Windows Form Application**	**7 hours**
The Window Forms – Form Design Preference – Adding and qPositioning controls – Container controls -Docking and Anchoring controls -Window Presentation Foundation – Styling your application		
Module:6	**ASP.NET Web Forms**	**7 hours**
Creating Web Projects – Designing web Forms -Web Controls -Master pages- Model View Controller		
Module:7	**ADO.NET Entity Framework**	**7 hours**
Introduction to ADO.Net – Creating Entity model – Querying Entity Model -Advanced Functionality		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Alessandro Del Sole , “Visual Basic 2015 Unleashed”,2015, First Edition, SAMS
2. Bruce Johnson, “Professional Visual Studio 2017”,2017, First Edition, Wrox publications

Reference Books

1. Dirk Strauss, “C# 7 and .NET Core Cookbook”, 2017, Second Edition, Packt

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
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Course Code	Course Title	L	T	P	C

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CHENNAI

UCSC207P	Visual Programming Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To learn programming constructs in .NET
2. To solve object oriented and GUI programming in .NET
3. To understand and apply disconnected architecture of .NET

Course Outcomes:

1. Apply the features of .NET and VB. NET with GUI based applications
2. Comprehend and apply Object Oriented applications using VB.NET
3. Develop web applications using ASP.NET and solve database applications using ADO.NET

Indicative Experiments		Hours
1.	Develop a basic application using VB.NET	2 hours
2.	Understanding arrays and programming constructs of VB.NET	2 hours
3.	Develop Window based applications using VB.NET	4 hours
4.	Creating Object Oriented applications using VB.NET	4 hours
5.	Performing inheritance in VB.NET	2 hours
6.	Using Interfaces to develop application in VB.NET	2 hours
7.	Developing an event-based application using delegates	4 hours
8.	Developing a web application using ASP.NET	4 hours
9.	Creating database applications using ADO.NET	4 hours
10.	Creating stateful web application using ASP.NET	2 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1. Alessandro Del Sole , “Visual Basic 2015 Unleashed”,2015, First Edition, SAMS
2. Bruce Johnson, “Professional Visual Studio 2017”,2017, First Edition, Wrox publications

Reference Books

1. Dirk Strauss, “C# 7 and .NET Core Cookbook”, 2017, Second Edition, Packt

Mode of assessment: CAT, Exercises and FAT

Recommended by Board of Studies	01-11-2023		
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Course Code	**Course Title**	**L**	**T**	**P**	**C**

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UCSC208L	Linux Programming	3	0	0	3
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To make the students familiar with Linux environment through commands and shell scripts
2. To make students understand the file structure in Linux and be able to manage files and directories.
3. To help students understand system calls, processes and inter-process communication and introduce the basics of socket programming

Course Outcomes:

1. Understanding basic Linux commands and explore the Linux environment using the utilities.
2. Develop shell scripts to perform complex tasks in Linux environment
3. Understand the file systems and manage file and directories using system calls
4. Implement various process management applications using C programs.
5. Design Inter Process Communication in C using semaphores, named pipes, shared memory and client server application using sockets

Module:1	**Linux Fundamentals**	**5 hours**

Introduction to Linux OS, Linux Commands, Understanding Linux Directories, File Management, File Permission-Basic Utilities/Commands- Text Processing utilities and backup

Module:2	**Shell Programming**	**7 hours**

Introduction to Shell and its types, Variables, Operators, Branching and Loop control Structures, Quoting Mechanism, Arrays, Shell Substitutions, I/O Redirection and Shell Functions

Module:3	**Environment Variables and System Calls**	**7 hours**

Environment Variables for Date, Time, Files, Host and User Logging. File System Hierarchy standard, System Calls and Device Drivers, Library Functions, Low Level File Access, Standard I/O Library, File and Directory Maintenance, Scanning Directories, errors, /proc file system, fctnl and mnap

Module:4	**File Management**	**7 hours**

Introduction to File system, inode (Index Node), file descriptors, File System calls
File Management :File Structures, System Calls for File Management -Directory API

Module:5	**Process and Signals**	**6 hours**

Process, process identifiers, process structure: process table, viewing processes, system processes, process scheduling, starting new processes: waiting for a process, zombie processes, orphan process, fork, vfork, exit, wait, waitpid, exec, signals functions, unreliable signals, interrupted system calls, kill, raise, alarm, pause, abort, system, sleep functions, signal sets

Module:6	**Process Communication**	**6 hours**

Inter Process Communication: Pipe, process pipes, the pipe call, parent and child processes, and named pipes: fifos, semaphores: semget, semop, semctl, message queues: msgget, msgsnd, msgrcv, msgctl, shared memory: shmget, shmat, shmdt, shmctl, ipc status commands

Module:7	**Introduction to Socket Programming**	**5 hours**

Introduction to Sockets : Socket, socket connections - socket attributes, socket addresses, BSD Socket System Calls, Client/Server Programming

Module:8	**Contemporary Topics**	**2 hours**

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Neil Mathew, Richar Stones, “Beginning Linux Programming”, 2015, Fifth Edition, Wiley Publications	
Reference Books		
1.	Robert Love, “Lunx System Programming : Talking Directly to the kernel and C Library”,2013, Second Edition, O Reilly Media.	
2.	John Masters, Richard Blum, “Professional Linux Programming”, 2007, Linux® Bible, Ninth Edition Published by John Wiley & Sons, Inc	
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar		

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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Course Code	Course Title	L	T	P	C
UCSC208P	Linux Programming Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To familiarize basic concepts of shell programming.
2. To demonstrate use of system calls for IPC.
3. To demonstrate Socket Programming.

Course Outcomes:

1. Use shell script to create files and handle text documents
2. Create child processes, background process and zombies
3. To Simulate the IPC and Socket Programming.

Indicative Experiments	Hours
1. Study and Practice on various commands like man, passwd, tty, script, clear, date, cal, cp, mv, ln, rm, unlink, mkdir, rmdir, du, df, mount, umount, find, unmask, ulimit, ps, who, who am i.	2 Hours
2. Study and Practice on various commands like cat, tail, head , sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, tar, cpio. a. Write a Shell Program to print all .txt files and .c files. b. Write a Shell program to move a set of files to a specified directory. c. Write a Shell program to display all the users who are currently logged in after a specified time. d. Write a Shell Program to wish the user based on the login time.	4 Hours
3. Simulate the Process Management (Child Creation, Deletion …)	2 Hours
4. a)Simulate head command. b) Simulate tail command.	2 Hours
5. a) Simulate mv command. b) Simulate nl command.	2 Hours
6. Write a program to handle the signals like **SIGINT**, **SIGQUIT**, **SIGFPE**.	4 Hours
7. Implement the following IPC forms i. FIFO (Named Pipes), Signals and PIPE ii. IPC Resources (Shared Memory, Message Queues and Semaphore)	4 Hours
8. Implement message queue form of IPC.	
9. Implement shared memory form of IPC.	4 Hours
10. Write a Socket program for any application (Using TCP/IP and UDP/IP)	2 Hours 4 Hours
Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Neil Mathew, Richar Stones, “Beginning Linux Programming”, 2015, Fifth Edition, Wiley Publications

Reference Books

1.	Robert Love, “Lunx System Programming : Talking Directly to the kernel and C Library”,2013, Second Edition, O Reilly Media.
2.	John Masters, Richard Blum, “Professional Linux Programming”, 2007, Linux® Bible, Ninth Edition Published by John Wiley & Sons, Inc

Mode of assessment: CAT, Exercises and FAT			
Recommended by Board of Studies	01-11-2023		
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Course Code	Course Title	L	T	P	C
UCSC209L	Data Mining	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To introduce the fundamental processes and major issues in Data Mining.
2. To present the various descriptive techniques involved in Data Mining.
3. To understand the importance of distinct predictive modelling techniques used in Data Mining Applications.

Course Outcomes:

1. Recognize key areas and issues in data mining.
2. Prepare the data needed for data mining using preprocessing techniques.
3. Identify efficient descriptive data mining techniques and its importance.
4. Develop the solutions using predictive modelling algorithms for solving practical problems.
5. Apply various kinds of clustering algorithms for real-world application scenarios.

Module:1	**Introduction to Data Mining**	**6 hours**
Data mining : an essential step in knowledge discovery - Diversity of data types for data mining - Mining various kinds of knowledge - Data mining: confluence of multiple disciplines - Data mining and applications		
Module:2	**Data Pre-processing**	**6 hours**
Data Types - statistics of data -similarity and distance measures - data quality, data cleaning and data integration – data transformation – dimensionality reduction		
Module:3	**Association Rules**	**7 hours**
Market basket analysis - frequent itemsets and association rules - efficient and scalable frequent itemset mining methods: Apriori algorithm, generating association rules from frequent itemsets, FP Growth algorithm		
Module:4	**Classification & Prediction**	**9 hours**
Basic Concepts - Decision Tree Induction: Attribute Selection Measures, Tree Pruning - Rule Based Classification - Using IF-THEN Rules for Classification, Rule Extraction from a Decision Tree - Bayes Classification Methods - Bayes' Theorem, Naive Bayesian Classification - Lazy Learner - Prediction - Linear Regression		
Module:5	**Model Evaluation and Selection**	**6 hours**
Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub-sampling, Cross - Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost – Benefit and ROC Curves		
Module:6	**Clustering**	**6 hours**
Cluster analysis - Partitioning methods: k-means - Hierarchical methods: agglomerative and divisive clustering methods - Evaluation of clustering - Outlier detection - types of approaches		
Module:7	**Applications of Data Mining**	**3 hours**
Applications - Data Mining for Financial Data Analysis - Data Mining in Science and Engineering - Data Mining and Recommender Systems		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Jiawei Han, Jian Pei, Hanghang Tong, "Data Mining : Concepts and Techniques",2022, Fourth edition, Elsevier - Morgan Kaufmann Publications.

Reference Books

1.	Max Bramer, "Principles of Data Mining",2020, Fourth Edition, Springer
2.	Ian H.Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, "Data Mining Practical Machine Learning Tools and Techniques", 2016, Fourth Edition, Morgan Kaufman Publications

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C

UCSC210L	Software Project Management	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand software project evaluation, estimation, planning and risk management
2. To apply process in team building, monitoring, and control of software projects
3. To function the monitoring and control process in real time software projects

Course Outcomes:

1. Identify the fundamentals of project management and software project types to plan efficiently
2. Design a critical path for the project's activities before performing PERT for risk management
3. Estimate the software effort, functions, and cost
4. Examine visualization techniques for the monitoring and management of Software project activities
5. Inspect the control activities of the project, manage contracts, people and team

Module:1	**Introduction**	**5 hours**
Importance of SPM - Software Project vs other Projects - Activities in SPM – Plans, Methods and Methodologies – Stakeholders - Setting Objectives - Business Case - Traditional Vs. Modern Project Management Practices		
Module:2	**Project Evaluation and Programme Management**	**8 hours**
Business case - Project Portfolio Management - Evaluation of Individual Projects - Cost-benefit Evaluation Techniques - Risk Evaluation - Programme Management - Strategic Programme Management - Benefits Management		
Module:3	**Software Effort Estimation**	**7 hours**
Problems with Over and Under Estimates – Basics for Software Estimation - Software Effort Estimation Techniques – Bottom-up Estimating – Top-down approach and Parametric models - Albrecht Function Point Analysis, Cost Estimation – Staffing Pattern		
Module:4	**Activity Planning**	**5 hours**
Objectives - Project Schedules - Projects and Activities - Sequencing and Scheduling Activities - Network Planning Models - Adding Time Dimension - Forward and Backward Pass - Identifying the critical path - Activity Float - Shortening the project duration – identifying the critical activities – Activity-on-Arrow Networks		
Module:5	**Risk Management**	**6 hours**
Categories of Risk – A Framework for dealing with Risk - Identification - Assessment - Planning - Management – Evaluating Risks to the Schedule - Applying the PERT technique - Monte Carlo simulation - Critical chain concepts		
Module:6	**Resource Allocation**	**6 hours**
The nature of resources - Identifying Resource Requirements - Scheduling Resources - Creating Critical Paths - Counting the cost - Publishing the Resource Schedule - Cost Schedule – Scheduling Sequence		
Module:7	**Monitoring and Control**	**6 hours**
Creating the framework – Collecting the Data – Review - Project Termination Review - Visualizing Progress – Cost Monitoring – Earned Value Analysis - Prioritizing Monitoring - Change Control		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Bob Hughes, Mike Cotterell, Rajib Mall, “Software project management”, 2017, Sixth Edition, Mc Graw Hill

Reference Books

1.	John Nicholas and Herman Steyn, “Project management for Engineering, Business and Technology”,

	2021, Routledge			
2.	Ramesh Gopalaswamy, “Managing Global Projects”, 2017, First Edition, Tata McGraw Hill			
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar				
Recommended by Board of Studies	01-11-2023			
Approved by Academic Council	No. 72	Date	13-12-2023	

Course Code	Course Title	L	T	P	C
UCSC211L	Object Oriented Analysis and Design	3	0	0	3

Pre-requisite		Syllabus version
		v.1.0

Course Objectives:

1. To understand the basic principles of object orientation and notation.
2. To experiment with Unified Modeling Language.
3. To analyze and design the requirements of software development using UML

Course Outcomes:

1. Analyze the fundamentals of object-oriented design elements.
2. Comprehend the limitations of object-oriented analysis and design.
3. Recognize the object modeling and emerging phases of UML.
4. Apply UML with static and dynamic behavior for an interactive design process.
5. Design form which maps to implementation in the real-life applications.

Module:1	**Introduction**	**6 hours**
Object Oriented Systems Development - Object basics - Object Oriented Development Life Cycle		
Module:2	**Object Oriented Methodologies**	**7 hours**
Rumbaugh et al.'s object modeling technique - The Booch Methodology - The Jacobson et al. Methodologies - The Unified Approach		
Module:3	**Unified Modeling Language**	**6 hours**
Fundamentals of Modeling - Principles of modeling - Use-Case diagram - Class diagram – Identifying attributes, operations, Object diagram		
Module:4	**Dynamic Modeling – I**	**6 hours**
Activity diagram – Action States, Activity States, Swimlane activity diagram - Statechart diagram – States, events, triggers - Sequence diagram – Object Lifeline, Focus of Control		
Module:5	**Dynamic Modeling – II**	**6 hours**
Collaboration diagram - Component diagram – source code, executable program, user interface - Deployment diagram – runtime processing elements, software components		
Module:6	**Object Analysis Classification**	**6 hours**
Approaches for Identifying Classes – Noun Phrase Approach – Selecting Classes from the relevant and Fuzzy Categories - Common Class Patterns		
Module:7	**Case Studies**	**6 hours**
Library Management System - Online Shopping System - Weather Forecasting system - Employee payroll management system		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Textbook(s)

1	Ali Bahrami," Object Oriented Systems Development", Tata McGraw-Hill, 2021.

Reference Books

1	Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen, Kelli A. Houston, "Object Oriented Analysis and Design with Application",2011, Third edition, Addison Wesley.
2	Grady Booch, Ivar Jacobson, James Rumbaugh, "The Unified Modelling Language User Guide",2012, Second Edition, Pearson.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC302L	**Mobile Application Design and Development**	**3**	**0**	**0**	**3**

Pre-requisite		Syllabus version
		v. 1.0

Course Objectives:

1. To impart fundamental concepts of Mobile Application Design and Development.
2. To design user interfaces for interacting with apps and triggering actions.
3. To identify options to save persistent application data.

Course Outcomes:

1. Design highly functional and modern user interfaces.
2. Create, test and debug mobile application by setting up a development environment.
3. Implement interactive user interfaces that work across a wide range of devices.
4. Demonstrate methods for storing and retrieving data in mobile applications.
5. Analyse performance of mobile applications and understand the role of permissions and security.

Module:1	UX design for Mobile	6 hours
Design Principles and General Design Planning - Mobile Patterns - Web application approaches - Mobile application design patterns - Mobile user interface design patterns -Mobile design behaviour patterns-Wireframes and Mockups		
Module:2	**Introduction to Development Environment**	**6 hours**
Introduction to Android - Obtaining the Required tools – Launching First Mobile Application – Exploring the IDE – Using Code Completion – Debugging the application		
Module:3	**Activities, Fragments and Intents**	**6 hours**
Understanding Activities – Linking Activities using Intents – Fragments- Adding Fragments Dynamically, Life Cycle of a Fragment- Displaying Notifications		
Module:4	**Know the Android User Interface**	**6 hours**
Understanding the Components of a Screen-Views and ViewGroups, Linear Layout, Frame Layout, Table Layout, Scroll View – Adapting to Display orientation – Utilizing the Action Bar		
Module:5	**Designing User Interface with Views**	**7 hours**
Using Basic Views – Using Picker Views – Using List Views to display Long Lists – Understanding Specialized Fragments - using a List Fragment, using a Dialog Fragment, using a Preference Fragment - Using Menus with Views- Options Menu, Context Menu		
Module:6	**Data Persistence and Content Providers**	**6 hours**
Saving and Loading User Preferences – Persisting Data to Files- Saving to Internal Storage, Saving to External Storage – Creating and Using Databases – Content Providers - Sharing Data in Android		
Module:7	**Messaging and Location-Based Services**	**6 hours**
SMS Messaging – Sending Email – Displaying Maps – Getting Location Data – Monitoring a Location		
Module:8	**Contemporary Issues**	**2 hours**
Expert Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book

1. Pablo Perea, Pau Giner, “UX Design for Mobile”, 2017, First Edition, Packt Publishing.
2. J F DiMarzio, “Beginning Android Programming with Android Studio”, 2017, Fourth Edition, Wiley India Pvt. Ltd.

Reference Books

1. Dawn Griffiths and David Griffiths, “Head First Android Development”, 2021, Third Edition, O’Reilly

	SPD Publishers.			
2.	Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", 2017, Google Developer Training Team			
3.	Neil Smyth, "Android Studio 3.0 Development Essentials", eighth edition , 2017, Payload Media Inc.			
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar				
Recommended by Board of Studies	01-11-2023			
Approved by Academic Council	No. 72	Date	13-12-2023	

Course Code	Course Title	L	T	P	C
UCSC302P	Mobile Application Design and Development Lab	0	0	2	1

Pre-requisite		Syllabus version
		v.1.0

Course Objectives:

1. To configure Android Studio to develop mobile application.
2. To understand and implement User Interface functions.
3. To create and store application data on database.

Course Outcomes:

1. Create, test and debug an Android application.
2. Implement adaptive and responsive user interface.
3. Demonstrate methods in storing, sharing and retrieving data.
4. Infer the role of permission and security for Android applications.

	Indicative Experiments	**Hours**
1.	UI Design - linear layout, relative layout, constraint layout	2 hours
2.	Usage of Widgets - checkbox, radio button, time picker, date picker	4 hours
3.	UI Operations - button click, dialog handling, list item selection	4 hours
4.	Intent – Activities moving to another activity, passing data between	4 hours
5.	Fragments - list fragment, dialog fragment	4 hours
6.	Menu - options menu, context menu	4 hours
7	Custom ListView - songs listview	4 hours
8.	Database - SQLite database	4 hours
	Total Laboratory Hours	30 hours

Text Book

1.	Pablo Perea, Pau Giner, “UX Design for Mobile”, 2017, First Edition, Packt Publishing.
2.	J F DiMarzio, “Beginning Android Programming with Android Studio”, 2016, Fourth Edition, Wiley India Pvt. Ltd.

Reference Books

1.	Dawn Griffiths and David Griffiths, “Head First Android Development”, 2021, Third Edition, O’Reilly SPD Publishers.
2.	Google Developer Training, "Android Developer Fundamentals Course – Concept Reference”,2017, Google Developer Training Team
3.	Neil Smyth, “Android Studio 3.0 Development Essentials”, Eighth edition, 2017, Payload Media Inc.

Mode of assessment: CAT, Exercises and FAT

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC303L	Cloud Application Development	3	0	0	3

Prerequisite		Syllabus version
		v.1.0

Course Objectives:

1. To learn cloud computing concepts and techniques.
2. To emphasize the understanding of virtualization and cloud application frameworks.
3. To appreciate concepts of programming paradigms, streaming of data and machine learning applications in cloud environments.

Course Outcomes:

1. Understand cloud computing and virtualization concepts in clouds.
2. Develop applications in cloud environments.
3. Understand the concepts of cloud storage services.
4. Apply data analytics techniques in clouds.
5. Explore possible ways for streaming data, and using machine learning techniques cloud environments.

Module:1	Introduction to Cloud Computing	4 hours
Characteristics- Cloud Models- Cloud Computing Concepts and Technologies- Cloud Computing Services and Platform- Case Studies		
Module:2	**Virtual Machines & Compute Services**	**6 hours**
Virtualization-Compute Services-Auto Scaling-Elastic Load Balancing-Virtual Private Cloud		
Module:3	**Cloud Application Development**	**6 hours**
Design Considerations - Cloud Application Design Methodologies - Reference Architectures - Designing a RESTful Web API- Serverless Applications		
Module:4	**Cloud Storage Services**	**7 hours**
Simple Storage Service - Elastic File System- Elastic Block Store- Storage Gateway- Relational (SQL) Databases- NoSQL Databases		
Module:5	**Big Data Analytics in Clouds**	**7 hours**
Analytics - Characteristics - Domain Specific Examples - Analytics Flow - Big Data Stack -Hadoop MapReduce - Oozie – Spark- Search.		
Module:6	**Queues & Connectors**	**6 hours**
Data Acquisition Considerations - Publish - Subscribe Messaging Frameworks- Big Data Collection Systems- Messaging Queues- Custom Connectors- Cloud Security		
Module:7	**Machine Learning in the Cloud**	**7 hours**
Spark Machine Learning Library- Azure Machine Learning Workspace- Amazon Machine Learning Platform- Deep Learning: A Shallow Introduction- Amazon MXNet Virtual Machine Image- Google TensorFlow in the Cloud.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Arshdeep Bahga & Vijay Madisetti, “Cloud Computing Solutions Architect: A Hands-On Approach”, First Edition, 2019, VPT Publisher
2	Ian Foster and Dennis B. Gannon, “Cloud Computing for Science and Engineering”, 2017, First Edition, The MIT Press, Cambridge, Massachusetts.

Reference Books

1	Douglas E. Comer, “The Cloud Computing Book: The Future of Computing Explained”, 2021, First Edition, CRC Press, Florida.		
2.	Naresh Kumar Sehgal, Pramod Chandra P. Bhatt, John M. Acken, “Cloud Computing with Security Concepts and Practices”, 2020, Second Edition, Springer Nature, Switzerland		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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Course Code	Course Title	L	T	P	C
UCSC303P	Cloud Application Development Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:				
1. To understand, analyze and design cloud applications. 2. To work on cloud programming paradigms.				
Course Outcomes:				
1. Create VMs to deploy cloud applications. 2. Develop applications using MapReduce programming model. 3. Use web APIs to develop cloud applications.				
Indicative Experiments				**Hours**
1	Create and host static websites using cloud service providers			3 hours
2	Create a VM and deploy an application			3 hours
3	Execute Simple Spark Programs			2 hours
4	Execute SQL commands using Python and Spark.			2 hours
5	Develop cloud application with python web application framework			4 hours
6	Develop applications using MapReduce programming model.			4 hours
7	Execute simple data analytics applications in cloud.			4 hours
8	Execute simple machine learning applications in cloud.			4 hours
	Develop real-world applications			4 hours
			Total Laboratory Hours	**30 hours**
Text Book(s)				
1	Arshdeep Bahga & Vijay Madisetti, “Cloud Computing Solutions Architect: A Hands-On Approach”, 2019, First Edition, VPT Publisher			
2	Ian Foster and Dennis B. Gannon, “Cloud Computing for Science and Engineering”, 2017, First Edition, The MIT Press, Cambridge, Massachusetts.			
Mode of assessment: CAT, Exercises and FAT				
Recommended by Board of Studies	01-11-2023			
Approved by Academic Council	No. 72	Date	13-12-2023	

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UCSC304L	Internet of Things	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			
Course Objectives:					

1. To understand the architecture, protocols and operations of IoT
2. To explore the IoT devices and its applications
3. To comprehend the programming skills to implement IoT based application

Course Outcomes:

1. Understand the concept and the layered architecture of IoT
2. Build hardware platforms encompassing, sensors, actuators, microcontrollers and peripherals
3. Analyze various communication access technologies and application protocols for IoT
4. Analyze the sensor data using various data analytics
5. Implement IoT based solutions for simple real world problems

Module:1	**Introduction to Internet of Things**	**7 hours**
Genesis of IoT - IoT and Digitization-Convergence of IT and OT - IoT Challenges- Drivers behind new Network Architectures - Simplified IoT Architecture - Core Functional IoT stack - Sensors and Actuators Layer, Communications Network Layer, Applications and Analytics Layer		
Module:2	**Smart Objects: The Things in IoT**	**7 hours**
Sensors – Actuators – MEMS (Micro - Electro - Mechanical Systems) - Smart Objects - Sensor Networks - Wireless Sensor Networks, Communication Protocols for WSN		
Module:3	**Connecting Smart Objects**	**7 hours**
Communications Criteria - IoT Access Technologies - IEEE 802.15.4 - LRWPAN - LoRAWAN – NB IoT - Bluetooth Low Energy (BLE) - WiFi/802.11 - IP for IoT Network Layer - Optimizing IP for IoT - 6LowPAN		
Module:4	**Application Protocols for IoT**	**6 hours**
Generic Web Based Protocols – IoT Application Layer Protocols - Constrained Application Protocol , Message Queue Telemetry Transport		
Module:5	**Data and Analytics for IoT**	**5 hours**
IoT Data Management and Compute Stack - Fog computing - Edge Computing - Hierarchy of Fog, Edge and Cloud - An Introduction to Data Analytics for IoT - Machine Learning - Big Data Analytics - Edge Streaming Analytics		
Module:6	**Programming in IoT**	**6 hours**
Development boards for IoT - Arduino, Arduino IDE - Serial Monitor - Arduino Interfacing with Sensors and Actuators - NodeMCU - Raspberry Pi – GPIO Pins - Remote Access to Raspberry Pi - Connecting to WiFi, Bluetooth.		
Module:7	**Applications of IoT – Case Studies**	**5 hours**
Smart Cities- Transportation- Health Care – Retail- Agriculture		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., & Henry, J. “IoT fundamentals: Networking technologies, protocols, and use cases for the internet of things” 2017, First Edition, Cisco Press

Reference Books

1.	Sudip Misra , Anandarup Mukherjee, Arijit Roy, “Introduction to IoT”, 2022, First Edition, Cambridge University Press
2.	Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri: “Internet of Things: Architectures, Protocols and Standards”, 2018, Wiley–Blackwell

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC304P	Internet of Things Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					
1. To explore various sensors and actuators used for IoT applications					

2. To understand the use of IoT devices to derive solutions for real world problems		
Course Outcomes:		
1. Build simple Arduino programs for simple I/O interfaces 2. Implement IoT based applications for simple real world problems		
Indicative Experiments		**Hours**
1.	Familiarization with Arduino Uno to get the values from sensors and turn on/ off the actuators	2 Hours
2.	Program to interface Arduino Uno with temperature and humidity sensor	2 Hours
3.	Program to interface Arduino with ultrasonic sensor	2 Hours
4.	Program to interface Arduino with object detection sensor and LED	2 Hours
5.	Program to interface Arduino UNO soil moisture sensor and servo motor	2 Hours
6.	Program to interface Arduino with PIR sensor	4 Hours
7.	Program to interface Arduino with MQ-2 sensor and buzzer.	4 Hours
8.	Program to interface Arduino with relay switch	4 hours
9.	Program to implement automatic irrigation system using Arduino and integrate with Thingspeak/ Blynk application	4 Hours
10.	Program to implement water tank monitoring system using NodeMCU and integrate with Blynk application to get notification in mobile and Email.	4 Hours
	Total Laboratory Hours	**30 hours**
Text Book(s)		
1.	Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., & Henry, J. “IoT fundamentals: Networking technologies, protocols, and use cases for the internet of things” 2017, First Edition, Cisco Press	
Mode of assessment: CAT, Exercises and FAT		
Recommended by Board of Studies	01-11-2023	
Approved by Academic Council	No. 72	Date 13-12-2023

Course Code	**Corse Title**	**L**	**T**	**P**	**C**
UCSC305L	Game Programming	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			
Course Objectives:					

1. To provide an in-depth introduction to technologies and techniques currently used in the game industry.
2. To understand game design and development.
3. To understand the processes, mechanics, issues in game design, and game engine development.

Course Outcomes:

1. Analyze the concepts of modeling, techniques, handling situations, and logic to demonstrate understanding
2. Examine the design specifications for games and synthesize them to design, develop, test, evaluate, debug, and modify code accordingly
3. Design unique gaming environments, levels and characters by choosing appropriate game strategies and patterns based on an analysis of past and present trends
4. Audit the techniques of using multiple scenes and data persistence to refine a game, based on the skills you learned for building and playing games

Module:1	**Introduction to Game Programming**	**5 hours**
Overview of game - Game engine - Structure of a Typical Game Team - Engine Differences Across Genres		
Module:2	**Game Engine Architecture**	**6 hours**
Real Time Game Architecture - Engine Support - Subsystem Start-Up and Shut-Down - Memory Management - Containers and Strings		
Module:3	**Game Objects and Models**	**7 hours**
Dimensions and Coordinate system - Game objects – Transforms – Translation – Rotation – Scaling – Textures - Shaders and Materials – Prefabs – Sprites		
Module:4	**Graphics for game programming**	**7 hours**
The Rendering Pipeline - Lighting and Global Illumination - Visual Effects and Overlays - Basics of Tile map - Palettes and Tiles		
Module:5	**Game Physics and User Interfaces**	**7 hours**
Physics in Game - Collision Detection System - Rigid Body Dynamics - Integrating a Physics Engine into Game - Basic UI Principles - The canvas - UI Elements – Images – Text – Buttons - Screen Space – Overlay - Camera		
Module:6	**Scripting**	**7 hours**
Variables – Operators – Conditionals – Iteration – Methods – Input - Accessing Local Components - Accessing other Components		
Module:7	**Audio and Level Design**	**4 hours**
Audio basics - Audio Sources - Audio Scripting - Managing scenes - Persisting data and objects		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Jason Gregory, “Game Engine Architecture”, 2018, Third Edition, A K Peters/CRC Press.

2.	Mike Geig, Sams “Teach Yourself, UNITY 2018 Game Development in 24 hours”, 2018, Third Edition, Sams publishing

Reference Books			
1.	Sellers M. “Advanced game design: a systems approach”,2017. Addison-Wesley Professional.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UCSC305P	Game programming Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					

1. To understand the processes, mechanics, issues in game design, and game engine development. 2. To understand modeling, techniques, handling situations, and logics 3. To build and integrate technologies such as multimedia, and physics modeling into a cohesive, interactive game application.
Course Outcomes:
1. Design, develop, test, evaluate, debug, and modify code to meet design specifications for games. 2. Design unique gaming environments, levels and characters by choosing appropriate game strategies and patterns based on an analysis of past and present trends. 3. Able to build and then integrate technologies such as multimedia, and physics modelling into a cohesive, interactive game application.

Indicative Experiments		Hours
1.	Game engine - UNITY Basics	3 hours
2.	Model Creation	3 hours
3.	2D Game environment	3 hours
4.	3D Game environment	3 hours
5.	Create a game environment to apply different types of light effects.	3 hours
6.	Create a physics based game play to realize all basic Newtonian effects	3 hours
7.	Incorporating User Interface elements	3 hours
8.	Create a Tile map based Game environment	3 hours
9.	Apply Multiple Levels for any of the Games developed	3 hours
10.	Apply audio effects for events and background	3 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)	
1.	Mike Geig, Sams, “Teach Yourself, UNITY 2018 Game Development in 24 hours”, Third Edition, 2018, Sams publishing
Reference Books	
1.	Felicia P,” Unity From Zero to Proficiency (Foundations): A step-by-step guide to creating your first game with Unity”, 2017, Patrick Felicia;
2.	Shankar AR, “Pro HTML5 Games: Learn to Build Your Own Games Using HTML5 and JavaScript”,2017, Apress.

Mode of assessment: CAT, Exercises and FAT			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UCSC306L	Soft Computing	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					

1. To comprehend with the Neural Network models, understand their functionalities and apply these in real life situations.
2. To understand the importance of approximation over exactness through the Fuzzy set model, basic concepts and principles of Fuzzy sets.
3. To develop approximate reasoning and fuzzy rules with applications in fuzzy inference engine.
4. To illustrate the importance of evolutionary computation, its categories with special focus on Genetic algorithms and optimization techniques.

Course Outcomes:

1. Understand the fundamental concepts of neural networks to soft computing problems
2. Deploy the learning mechanism of neural networks for classification and clustering problems
3. Design the fuzzy inference systems for machine intelligence problems.
4. Develop applications using Fuzzy logic control to solve decision making problems
5. Demonstrate the concepts of genetic algorithm and hybrid systems for optimization problems

Module:1	**Soft Computing Fundamentals**	**7 Hours**
Introduction to Intelligent systems and Soft Computing - Artificial Neural Network - Biological Neural Networks - Introduction, Evolution - Basic Models - Mcculloch-Pitts Model, Hebb's Network-implementing OR, AND and XOR logic functions.		
Module:2	**Supervised Neural Networks**	**6 Hours**
Supervised Neural Networks – Perceptron-MLP- Adaline (Adaptive Linear Neuron)- Back-Propagation Network - Radial Basis Function Network.		
Module:3	**Associative Memory Networks**	**6 Hours**
Pattern Association - Memory Models -Auto-Associative and Hetero Associative Models - Bi Directional Associative Memory Model.		
Module:4	**Unsupervised Neural Networks**	**6 Hours**
Kohonen Self-Organizing Feature Maps, Learning Vector Quantization Network, Adaptive Resonance Theory Network		
Module:5	**Fuzzy Sets and Fuzzy Relations**	**6 Hours**
Introduction - Fuzzy Sets – Operations - Fuzzy Relations - Membership Functions -Fuzzification and Defuzzification.		
Module:6	**Fuzzy Logic and Approximate Reasoning**	**6 Hours**
Fuzzy Truth Values - Fuzzy Propositions, Fuzzy Rules, Formation, Decomposition and Aggregation of Rules, Fuzzy Reasoning - FIS.		
Module:7	**Genetic Algorithm**	**6 Hours**
Basic Concepts of Genetic Modeling - Encoding, Selection, Crossover, Mutation, Reproduction, Applications in Search and Optimization.		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Sivanandam and S N Deepa, "Principles of Soft Computing", 2018, Third Edition, Wiley Publications.

Reference Books

1. S. Rajasekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & Applications", 2017, Second Edition., PHI Publication

2.	George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic: Theory and Application”, 2015, Pearson Publication.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC307L	**Cyber Forensics**	**3**	**0**	**0**	**3**
Prerequisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To understand the basics of cybercrime, Cyber forensics technology, systems and services.

2. To learn about Digital Evidence, Acquisition, Handling, Analysis and Admissibility.
3. To familiar with different tools for cyber forensics acquisition and analysis.

Course Outcomes:

1. Illustrate the fundamentals of cybercrime, cyber forensics, digital evidence and quality control procedures.
2. Demonstrate the process of forensic data acquisition and analysis and investigate artifacts in different scenarios.
3. Apply the procedure to perform Recover, seize, analysis and admissibility of digital evidences using legal procedures and standards.
4. Prepare for the documentation and presentation based on the legal perspectives.
5. Experiment the forensic procedures with the tools efficiently .

Module:1	**Introduction to Cybercrime**	**5 hours**
Introduction - Role of ECD and ICT -Types - Classification -Strategies to Prevent Cybercrimes-Cyber War-Cryptocurrency-Blockchain- Ransomware- Deep Web and Dark Web.		
Module:2	**Introduction to Cyber Forensics**	**5 hours**
Steps in Forensic Investigation - Forensic Examination Process - Classification-Incident and Incident Handling - Incident Response Team.		
Module:3	**Digital Evidence**	**7 hours**
Types - Evidence Collection Procedure-Sources of Evidence - Operating Systems, Storage Medium, File Systems – Registry – Artifacts - Impediments to Collection- Challenges.		
Module:4	**Acquisition and Handling of Digital Evidence**	**6 hours**
Preliminaries - Acquisition and Seizure- Chain of Custody - Collection Form- - Acquisition Procedure - Challenges- Handling - Precautions Involved.		
Module:5	**Analysis and Admissibility of Digital Evidence**	**7 hours**
Capturing of Forensic Copy - Email Tracking - Role of Forensic Analyst- Electronic Record: Retention-Rules of Admissibility - Categorization- Pre-trial Preparation- Presenting- Summary of Investigation Process.		
Module:6	**Introduction to Cyber Laws**	**6 hours**
Need - Cyber Laws and Legal Issues - Minimizing Risk - Initiatives Promoting Cyber Security- Terms and Terminologies- Indian Cyber Laws- International Cyber Laws.		
Module:7	**Forensic Tools**	**7 hours**
Types- Drive Imaging and Validation- Integrity Verification- Data Recovery- Registry Analysis- Password Recovery- Network Analysis - Email Analysis-Metadata Processing.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Dejey and Murugan, “Cyber Forensics”, 2018, Oxford University Press,

Reference Books

1.	John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, 2015, Second Edition, Charles River Media, Inc.
2.	B. Nelson, A. Phillips, F. Enfinger, and C. Steuart, “Guide to Computer Forensics and Investigations”, 2019, Sixth Edition. CENGAGE,

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Course Code	Course Title	L	T	P	C
UCSC308L	Wireless Networks	3	0	0	3
Pre-requisite		**Syllabus version**			
		1.0			
Course Objectives:					
1. To learn the concepts of wireless network and communication 2. To understand and solve problems of modulation and coding schemes					

3. To learn cellular systems, WLAN, WPAN networks		
Course Outcomes:		
1. Interpret the concepts of wireless communications and wireless networking 2. Explore and solve problems associated with modulation and coding schemes 3. Identify and analyse cellular concepts, WLAN and WPAN. 4. Analyse and solve fundamental problems in wireless networks and security 5. Explore reading good research papers in wireless networks		
Module:1	**Introduction**	**6 hours**
Global Cellular Network - Mobile Device Revolution - Transmission Fundamentals: Signals for conveying Information – Analog and Digital Data Transmission – Channel Capacity – Transmission media -Multiplexing		
Module:2	**Overview of Wireless Communication**	**6 hours**
Wireless Channel Digital Signal Encoding Techniques – Coding and Error Control - Orthogonal Frequency Division Mutiplexing - Spread Spectrum – Wireless Channel		
Module:3	**Wireless LAN Technology**	**6 hours**
IEEE 802.11 Architecture - IEEE 802.11 Architecture and services – Medium Access Control – Physical Layer – Gigabit WI-FI – IEEE 802.11 standards – IEEE 802.11i Wireless LAN Security		
Module:4	**Bluetooth and IEEE 802.5**	**6 hours**
The Internet of things – The Bluetooth motivation and overview – Bluetooth Specification – Bluetooth High Speed and Bluetooth Smart – IEEE 802.5 – Zigbee		
Module:5	**Cellular Wireless Networks**	**6 hours**
Principles of Cellular Networks – First Generation Analog – Second Generation TDMA – Second Generation CDMA – Third Generation Systems		
Module:6	**Fourth Generation Systems and LTE**	**7 hours**
Purpose, motivation and approach - LTE Architecture - Resource Management - Channel Structure and Protocol - Radio Access Network		
Module:7	**Long Range Communication**	**6 hours**
Satellite parameters and configurations – Satellite capacity allocation – Satellite Application – Fixed Broadband wireless Access – WiMAX/IEEE802.16-Smart Grid		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Cory Beard and William Stallings “Wireless Communication Networks and Systems” ,2016, Pearson Education.
Reference Books	
1.	Krishnamoorthy Raghunandan, “Introduction to Wireless Communication and Networks A Practical Perspective”, 2022, Springer
2.	Arumita Biswas and Mainak Chowdary , “Wireless Communication Theory and Applications” , 2017,Cambridge University press.
3.	ITI Saha Misra, “Wireless Communications and Networks: 3G and Beyond”, 2017, McGraw Hill

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Course Code	Course Title	L	T	P	C
UCSC309L	Edge Computing	3	0	0	3
Pre-requisite		**Syllabus version**			
		1.0			
Course Objectives:					
1. To understand the basic knowledge on IoT, Edge computing 2. To analyze, design edge-based solutions.					

3. To explore the entrepreneurial aspect of the Edge computing and its security		
Course Outcomes:		
1. Understand the basic requirements of edge computing protocols and modules 2. Develop the key architectures and applications in edge computing 3. To explore knowledge on communication protocols for edge base technologies 4. Differentiate cloud and edge computing services. 5. Identifying the machine learning concepts for edge computing		
Module:1	**IoT and Edge Computing Definition and Use Cases**	**5 hours**
Introduction to IoT and Use cases -Example use cases and -deployment for edge computing- Far edge architecture-Edge layer architecture.		
Module:2	**IoT Architecture and Core IoT Modules**	**5 hours**
A connected ecosystem-IoT versus machine-to-machine-IoT and edge architecture-Role of an architect-Core Modules: Sensing and power- Data communication-Edge computing-compute-analytics and-machine learning-Threat and security		
Module:3	**Communication protocols for edge computing**	**9 hours**
IP based WPAN and WLAN:6LowPAN-IEEE802.11, 6LoWPAN topologies,6LowPAN protocol stack-WPAN IP-Thread-**Long range communications and protocols (WAN)**:4G LTE 5G-LoRA, LoRAWAN and Sigfox- **Edge to Cloud protocols:** MQTT- MQTT-SN- CoAP- Other protocols		
Module:4	**Edge Computing, routing and networking**	**6 hours**
Edge computing purpose and definition-Edge platforms and use cases for edge computing-Edge routing and networking: TCP/IP Network functions at the edge.		
Module:5	**Cloud and Fog Topologies**	**6 hours**
Cloud service model- public, private-hybrid cloud- open stack cloud architecture-Fog computing		
Module: 6	**Data Analytics and Machine learning in the cloud and edge**	**4 hours**
Big data analytics in IoT- ML in IoT-Convolutional Neural Networks		
Module:7	**Edge computing using Raspberry Pi & Edge Security**	**9 hours**
Cybersecurity vernacular-Anatomy of IoT cyber-attacks- Physical and hardware security-Block chains and cryptocurrencies-IoT security best practices-IoT Edge computing with RaspberryPi (Pi as camera and Image processing)-Industrial and Commercial IoT and Edge-Edge computing and solutions.		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Perry Lea, IoT and Edge Computing for Architects",2020, Second Edition, Packt Publishing
2.	Simon Monk, "Raspberry Pi Cookbook", 2019, Third Edition O'Reilly Media, Inc
Reference Books	
1.	David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE",2019, Apress
2.	Rajkumar Buyya, Satish Narayana Srirama,"Fog and Edge Computing: Principles and Paradigms ",2019, Wiley

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Vellore Institute of Technology
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Course Code	Course Title	L	T	P	C
UCSC310L	**Advanced Java Programming**	**3**	**0**	**0**	**3**
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					
1. To apply the core Java fundamentals to learn the advanced concepts of Java programming					

2. To design and develop web application and database connectivity using Servlets, JSP, and JDBC
3. To understand the fundamental concepts of JavaBeans and Springs

Course Outcomes:

1. Design and develop server-side programming using Servlets
2. Develop web applications using JSP
3. Understanding the properties of JavaBeans and the creation of software components using the Java platform
4. Demonstrate spring framework and use them in appropriate applications
5. Apply various methods for web application development

Module:1	**Web Application Architecture Fundamentals**	**4 hours**
HTTP-Web Application Architecture-Application Server- Web Server- Deployment Descriptor Overview-Deployment-Web Fragments - Configuring Tomcat server		
Module:2	**Servlet API**	**6 hours**
Introduction to Servlets- Life cycle of servlets, Servlet Configuration, Java Servlets Development Kit, Request and Response Handling, Compiling and running servlet, The servlet API: javax. servlet package, Reading the servlet Parameters, Reading Initialization parameter		
Module:3	**Servlet and JDBC**	**6 hours**
Session Management, Servlet Security, Error Handling, File upload and File download, Servlets and JDBC,		
Module:4	**Java Server Pages**	**7 hours**
Advantage of JSP technology, Introduction to J2EE Architecture, JSP Architecture, JSP Syntax (Directives, Declarations, Expression, Scriptlets, Comments)		
Module:5	**JSP-Development and Management**	**7 hours**
Implicit Objects, JSP Expressions, JSP Scriptlets, JSP Tag Libraries, JSP Exception Handling, Session Management, JSP and Servlet Integration, Custom tags - Using javabeans in JSP - MVC architecture		
Module:6	**Overview of Spring Framework**	**6 hours**
Spring Framework: Initializing a Spring application, Writing a Spring application, and Surveying the Spring landscape		
Module:7	**Spring-Web Applications**	**7 hours**
Developing Spring web applications -Displaying information, Processing form submission, Validating form input. Working with view controllers, Choosing a view template library, and Caching templates		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Herbert Schildt, “The Complete Reference-Java”,2017, Eleventh Edition, Tata Mcgraw-Hill.

Reference Books

1.	Budi Kurniawan, “Servlet & JSP: A Tutorial, Brainy Software”, 2015,Second Edition, Brainy Software.
2.	Craig Walls, “Spring in Action”, 2020, Fifth edition, Manning Publication.
3.	Pankaj B. Brahmankar, “Advanced JAVA Programming, 2019, Tech Neo Publications.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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Course Code	Course Title	L	T	P	C
UCSC310P	**Advanced Java Programming Lab**	**0**	**0**	**2**	**1**
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					
1. To design and develop web applications and database connectivity using Servlets, JSP, and JDBC					

2. To design and develop web applications using RMI 3. To design and develop web applications using Java Beans and Spring Framework.		
Course Outcomes:		
1. Provide a basic understanding of server-based application development 2. Design and develop server-side programming using Servlets and JSP,Client-server applications using RMI 3. Design and develop web applications using Java Beans and Spring Framework		
List of Challenging Experiments (Indicative)		**No of hours**
1	Programs on handling request and responses in client-server communication using Java Servlets	6 hours
2	Programs on handling cookies and sessions in client-server communication using Java Servlets	2 hours
3	Programs on database connection using JDBC from Java Servlets in client-server communication	4 hours
4	Programs on handling request and responses in client-server communication using Java Server Pages (JSP)	4 hours
5	Programs on exception handling and session management in client-server communication using JSP	2 hours
6	Programs on database connection using JDBC from JSP in client-server communication	4 hours
7	Programs on JSP custom tags	2 hours
8	Programs on web application development using Java Beans	2 hours
9	Programs on web application development using Spring Framework	2 hours
10	Program to demonstrate the use of Hibernate and Spring integration	2 hours
	Total Lecture hours:	**30 hours**
Text Book		
1.	Jim Keogh, “J2EE The Complete Reference”,2017, McGraw Hill Education (India).	
Reference Books		
1.	Uttam Roy, ADVANCED JAVA PROGRAMMING, 2015, Oxford publication	
2.	Herbert Schildt, “Java The Complete Reference”,2021, Comprehensive Coverage of Java Language, Oracle Press, McGraw Hill Education.	

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC406L	Computer Graphics and Multimedia	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			
Course Objectives:					
1. To understand and design Graphics primitives					

2. To emphasize the understanding of 2D,3D graphics operation and 3D projection, viewing mechanism
3. To understand the basics of multimedia and compression techniques.

Course Outcomes:

1. Implement the graphics model and recognize the meaning of computer graphics terminologies and differentiate methods involved in developing graphics models
2. Design and develop real work graphics applications using 2D, 3D primitives and transformations
3. Implementing curves, projections and back-face detection on 3D rendering
4. Analyze the standard compression techniques for Audio and Video.

Module:1	**Computer Graphics Hardware**	**4 hours**
Video Display Devices - Raster-Scan Systems - Graphics Workstations and Viewing Systems - Input Devices - Hard-Copy Devices - Graphics Networks - Graphics on the Internet		
Module:2	**Graphics Output Primitives**	**6hours**
Coordinate Reference Frames - Specifying a Two-Dimensional World-Coordinate Reference Frame - OpenGL Point Functions - Line Functions 5 Curve Functions - Fill-Area Primitives - Polygon Fill Areas - Polygon Fill-Area Functions - Vertex Arrays - Pixel-Array Primitives		
Module:3	**Two-Dimensional Geometric Transformations**	**6 hours**
Basic Two-Dimensional Geometric Transformations - Matrix Representations and Homogeneous Coordinates - Inverse Transformations - Two-Dimensional Composite Transformations - Raster Methods for Geometric Transformations - Transformations between Two-Dimensional Coordinate Systems		
Module:4	**Three-Dimensional Geometric Transformations**	**7 hours**
Three-Dimensional Translation - Three-Dimensional Rotation - Three-Dimensional Scaling - Composite Three-Dimensional Transformations - Transformations between Three-Dimensional Coordinate Systems - Affine Transformations		
Module:5	**Visible-Surface Detection Methods**	**7 hours**
Classification of Visible-Surface Detection Algorithms - Back-Face Detection - Depth-Buffer Method - A-Buffer Method - Scan-Line Method - Depth-Sorting Method - BSP-Tree Method - Area-Subdivision Method - Octree Methods - Ray-Casting Method - Comparison of Visibility-Detection Methods - Curved Surfaces - Wire-Frame Visibility Methods		
Module:6	**Multimedia Basics**	**6 hours**
Introduction and definitions - Graphics and Image Data Representations- Multimedia Data Compression – Lossless Compression Algorithms-Lossy Compression Algorithms		
Module:7	**Multimedia Compression**	**7 hours**
Basic Video Compression Techniques- - Image Compression Standards - MPEG 1,2,4 Compression-H.264 Video Coding.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Donald Hearn, Pauline Baker," Computer Graphics with OpenGL - C Version",2014, Fourth Edition, Pearson Education

2	Ze-Nian Li, Mark S. Drew and Jiangchuan Liu, “Fundamentals of Multimedia”, 2021, Third Edition, Springer
Reference Books	
1.	James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, "Computer Graphics-Principles and practice", 2007, Second Edition, Pearson Education
2.	Ralf Steinmetz and Klara Nahrstedt, “Multimedia: Computing Communications &Application”, 2009, Pearson Education

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by the Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC406P	Computer Graphics and Multimedia Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:			
1. To understand, analyze and design graphics objects 2. To work on graphics packages both 2D and 3D			
Course Outcomes:			
1. Use of computer programming in creation of graphics object 2. Design of 2D&3D objects and curves. 3. Implementation of filling, clipping and visualization. 4. Design and animate objects using multimedia tools.			
	Indicative Experiments		**Hours**
1.	**2D API usage:** Learning of Graphics Programming Environment and usage of Graphics APIs. Modelling and visualization of real-world /artificial scene using 2D graphics primitives		2 Hours
2	**2D Graphics primitive:** Implementation of Circle Drawing algorithm Implementation of Line Drawing algorithm		4 Hours
3.	**2D Transformations:** Implement the 2-D transformations functions on 2-D graphic objects. Write a sample program to demonstrate the use of the various 2-D transformation		4 Hours
4.	**Clipping and Filling:** Implementation of Line clipping algorithms against the given rectangular window. Implementation of area and polygon filling		4 Hours
5.	**Curves:** Implementation of quadratic curves like Bezier and spline.		4 Hours
6.	**Projections:** Implementation of program to demonstrate the use of the 3D transformations and projections.		4 Hours
7.	**Interactive Graphics Programming:** Implementation of interactive graphics programming using mouse(like windows paint)		4 Hours
8.	**Adobe Photoshop:** Learn and Practice various tools, effects, layers and filters in Adobe Photoshop.		2 Hours
9.	**Adobe Flash Professional:** Animate the objects using motion tweening, shape tweening and guide layers. Implementations of layer by layer animation and frame animation. Design and animate a shining text effect in Flash using masking. Controlling of various scenes using buttons and action scripts.		2 Hours
		Total Laboratory Hours	**30 hours**
Text Book(s)			
1	Donald Hearn, Pauline Baker," Computer Graphics with OpenGL - C Version",2014, Fourth Edition, Pearson Education		
2	Conrad Chavez, Andrew Faulkner," Adobe Photoshop Classroom in a Book", 2022,Adobe press		
Mode of assessment: CAT, Exercises and FAT			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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Course Code	Course Title	L	T	P	C
UCSC407L	System Programming	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					

1. To understand, analyze and design various system software components.
2. To understand the basic system programming concepts.
3. To develop software systems that demonstrate the importance of technologies.

Course Outcomes:

1. Convert high-level program to machine-level program.
2. Understand the execution process of HLL programs.
3. Distinguish the basic design of various system programming concepts like assembler, loader and linker.
4. Illustrate the working principles of scanners and parsers in the compiler.
5. Implement various system tools like macro processors and debuggers.

Module:1	**Introduction to System Software and Language Processors**	**3 hours**
Introduction – System Programming - views of System Software - Language Processing Activities, Program Execution		
Module:2	**Machine Architectures**	**7 hours**
Simplified Instructional Computers (SIC) – SIC Machine Architecture, SIC/XE Machine Architecture, SIC Programming Examples - Traditional Complex Instruction Set Computer (CISC) Machines – VAX Architecture, Pentium Pro Architecture; RISC Machines – Ultra SPARC Architecture, PowerPC Architecture, Cray T3E Architecture		
Module:3	**Assembler**	**9 hours**
Basic Assembler functions – Machine Dependent Assembler Features - Machine Independent Assembler Features – Assembler Design options – Implementation Examples		
Module:4	**Loaders and Linkers**	**7 hours**
Basic Loader functions – Machine Dependent Loader Features - Machine Independent Loader Features – Loader Design options – Implementation Examples		
Module:5	**Macro Processors**	**7 hours**
Basic Macro Processor functions - Machine Independent Macro Processor Features - Macro Processor Design options - Implementation Examples		
Module:6	**Compilers**	**7 hours**
Basic Compiler functions – Machine Dependent Compiler Features - Machine Independent Compiler Features – Compiler Design options – Implementation Examples		
Module:7	**Interpreters & Debuggers**	**3 hours**
Benefits of Interpretation, Overview of Interpretation, The Java Language Environment, Java Virtual Machine, Editors, Debugging Monitors, Classification of Debuggers		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book

1.	Leland L. Beck ,"System Software: An Introduction to Systems Programming", 2020, Third Edition,Pearson.

Reference Book(s)

1.	Dhamdhere, "Systems Programming",2019, McGraw-Hill.
2.	R.K. Maurya, Anand A. Godbole, "System Programming and Compiler Construction", 2019, Dreamtech Press.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

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Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC407P	Systems Programming Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To study the architecture of a hypothetical machine, its assembly language, macro language
2. To know the design and implementation of assemblers.
3. To know the design and implementation of Linkers, Loaders, and Macro processors.

Course Outcomes:		
1. Have an understanding of foundation to design of assemblers. 2. Implement the understood design of macro processors concepts as programs. 3. Examine what happens during program compilation, linking, and loading 4. Understand the concepts and theory behind the implementation of high level programming languages.		
Indicative Experiments		
1.	Implement a symbol table with functions to create, insert, modify, search, and display	2hours
2.	Implement pass one of a two pass assembler symbol table preparation	2hours
3.	Implement pass one of a two pass assembler intermediate code preparation	2hours
4.	Implement pass two of a two pass assembler	2hours
5.	Implement an absolute loader	2hours
6.	Implement a relocating loader	2hours
7.	Implement pass one of a direct-linking loader	2hours
8.	Implement pass two of a direct-linking loader	2hours
9.	Implement a two pass macro processor	2hours
10	Implement a single pass macro processor	2hours
11	Implement a simple text editor	2hours
12	Implementation of Lexical analyzer	2hours
13	Implementation of any YACC program	2hours
14	Implementation of one of top-down parser	2hours
15	Implementation of one of bottom-up parser	2hours
	Total Laboratory Hours	**30 hours**
Text Book		
1.	Leland L. Beck ,"System Software: An Introduction to Systems Programming", 2020, Third Edition,Pearson.	
Reference Book(s)		
1.	Dhamdhere, "Systems Programming",2019, McGraw-Hill Education	
2.	R.K. Maurya, Anand A. Godbole, "System Programming and Compiler Construction", 2019, Dreamtech Press.	
Mode of assessment: CAT, Exercises and FAT		
Recommended by Board of Studies	01-11-2023	
Approved by Academic Council	No. 72	Date 13-12-2023

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UCSC408L	Robotics	3	1	0	4
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					
1. To elucidate the students on types of robots, components and working mechanism of manipulators. 2. To summarize and analyze the uses of sensors, actuators in robots 3. To familiarize the students with robot applications and future of robots.					

Course Outcomes:		
1. Understand the importance, role of microprocessors in robots, the positive and negative aspects of robots and applications of robots. 2. Classify the robots, components of manipulators, drive systems and work envelope 3. Explain the drive systems, grippers and gears in detail. 4. Analyze the role of sensors, control methods, actuators in robots. 5. Judge the uses of robot in present and their future world.		
Module:1	**Introduction**	**5 hours**
Introduction - Definition - Robot History - Computer Programs - Languages - Microprocessors - Positive Aspects of Robots - Negative Aspects of Robots - Robots - Hard Automation - and Human Labor - Robots and Humans - Robots Versus Humans - Industrial Robot Applications		
Module:2	**Robot types and Manipulators**	**7 hours**
Types of Robots - Base - Arm - Wrist - Grippers - All Together It Becomes a Manipulator - Work Envelope - Articulation - Wrist Motion - Degrees of Freedom - Robot Motion Capabilities - Wrist Action - Work Envelopes - Moving the Manipulator - Drive Systems.		
Module:3	**Drive systems, Grippers and Gears in Detail**	**7 hours**
Drive systems in detail - Hydraulics - Pressure - Pumps - Pneumatics - Motors - End Effectors - Grippers - End-of-Arm Tooling - Positioning - Repeatability and Accuracy - Drives & Gears - Adjusting Gears - Harmonic Drives - Belts - Chains.		
Module:4	**Sensors and Sensing**	**7 hours**
Classes of Sensors - Noncontact Sensors - Self-Protection - Collision Avoidance - Proximity Sensors - Range Sensors - Tactile (Touch) Sensors - Strain Gauges - Pulsed Infrared Photoelectric Control - Temperature Sensing - Displacement Sensing - Speed Sensing - Torque Sensing - Vision Sensors		
Module:5	**Control methods, Actuators and Programming a Robot**	**6 hours**
Control Methods - Servo-Controlled Robots - Non-Servo-Controlled Robots - Electric Non-Servo-Controlled Robots - Pneumatic Non-Servo-Controlled Robots - Hydraulic Non-Servo-Controlled Robots. Actuators - Controllers - Programming a Robot - Teach Pendant - Lead-Through Programming - Computer Terminal Programming.		
Module:6	**Uses of robots**	**6 hours**
Uses for Robots - Loading and Unloading - Lane Loader - Flow-Line Transfer - Machine Loading - Materials Handling - Die Casting - Palletizing - Line Tracking - Process Flow - Fabricating - Assembling - Painting - Welding - Inspecting and Testing - The Future of Flexible Automation		
Module:7	**Future and Advanced Systems**	**5 hours**
The Future of Robots - Social Impact of Robots - New Uses and New Forms - Robots and Robotics - Today and Advanced Systems - Software for Robots		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours: **Total Tutorial hours:**	**45 hours** **15 hours**
Text Book(s)		
1.	Mark R. Miller, Rex Miller, “Robots and Robotics (Principles, Systems, and Industrial Applications)”,2019, McGraw Hill	
Reference Books		
1.	John J. Craig, “Introduction to Robotics Mechanics and Control”,2022, Person Edition Limited	
2.	Saeed B. Nikku, “Introduction to Robotics Analysis, Control, Applications”,2020, John Wiley & Sons Ltd	
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar		
Recommended by Board of Studies	01-11-2023	

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Approved by Academic Council	No. 72	Date	13-12-2023

Course code	Course Title	L	T	P	C
UCSC409L	Cyber Physical Systems	3	1	0	4
Pre-requisite		**Syllabus version**			
		1.0			
Course Objectives					

1. To introduce the concepts of Cyber-Physical Systems
2. To obtain CPS fundamentals and principles knowledge as building blocks to promote further design and implementation of more complex real time systems.
3. To understand the systems that bridge the cyber-world of computing and communications with the physical world as cyber-physical systems with Logical Correctness for Hybrid Systems and security of Cyber-Physical System

Course Outcomes:

1. Understand the basics of Cyber Physical Systems(CPS)
2. Identify the important system principles in various application domain
3. Perceive the relationship between CPS and Wireless Sensor Network
4. Develop several symbolic synthesis models and techniques for CPS
5. Examine the software and platform issues in Feedback Control Systems with logical correctness, security and scheduling of CPS

Module:1	**Introduction to Cyber-Physical System**	**7 hours**
Introduction to Cyber-Physical System- Emergence of CPS - CPS Drivers - Application Domains of CPS - Theoretical Foundations: Basic principles of design and validation of CPS - Challenges in CPS		
Module:2	**Cyber Physical System Application Domain**	**7 hours**
Medical Cyber-Physical Systems: System Description and Operational Scenarios - Key Design Drivers and Quality Attributes - Quality Attributes and Challenges of the MCPS Domain - Energy Cyber-Physical Systems - System Description and Operational Scenarios - Key Design Drivers and Quality Attributes - Key Systems Principles		
Module:3	**Cyber-Physical Systems Built on Wireless Sensor Networks**	**7 hours**
System Description and Operational Scenarios - Medium Access Control - Routing - Node Localization - Clock Synchronization - Power Management - Key Design Drivers and Quality Attributes - Physically Aware - Real-Time Aware - Runtime Validation Aware - Security Aware - Practitioners' Implications		
Module:4	**Symbolic Synthesis for Cyber-Physical Systems**	**6 hours**
Introduction and Motivation - Basic Techniques - Solving the Synthesis Problem - Construction of Symbolic Models - Advanced Techniques - Construction of Symbolic Models - Continuous-Time Controllers		
Module:5	**Software and Platform Issues in Feedback Control Systems**	**6 hours**
Basic Techniques - Controller Timing - Control Design for Resource Efficiency - Reducing the Computation Time - Less Frequent Sampling - Event-Based Control - Controller Software Structures - Sharing of Computing Resources - Analysis and Simulation of Feedback Control Systems		
Module:6	**Logical Correctness for Hybrid Systems**	**5 hours**
Introduction and Motivation - Basic Techniques - Discrete Verification - Real-Time Verification - Hybrid Verification - Summary and Open Challenges		
Module:7	**Security of Cyber-Physical Systems**	**5 hours**
Cyber Security Requirements - Attack Model - Countermeasures - Advanced Techniques - System Theoretic Approaches - Synchronization in Distributed Cyber-Physical Systems - Challenges in Cyber-Physical Systems - A Complexity-Reducing Technique for Synchronization		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture Hours:	**45 hours**
	Total Tutorial Hours:	**15 hours**

Text Book(s)

1. Raj Rajkumar, Dionisio de Niz and Mark Klein, "Cyber-Physical Systems",2017 Addison-Wesley

Reference Books

1. Walid M. Taha Abd-Elhamid M. Taha Johan Thunberg, "Cyber- Physical Systems: A Model- Based Approach", 2021, Springer

2.	Nathan Ida, "Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction", 2020,Second Edition, IET			
3.	A.Platzer, “Logical Foundations of Cyber Physical Systems”, 2017, Springer.			
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar				
Recommended by Board of Studies	01-11-2023			
Approved by Academic Council	No. 72	Date	13-12-2023	

Course code	**Course Title**	**L**	**T**	**P**	**C**
UCSC410L	Augmented Reality and Virtual Reality	3	1	0	4
Pre-requisite		**Syllabus version**			
		v. 1.0			
Course Objectives :					
1. To understand the fundamental concepts of immersive technologies – Augmented Reality and Virtual Reality					

2. To gain knowledge on the various types, techniques, and modeling of AR and VR
3. To understand the working mechanism of AR and VR with the hardware and software requirements and methodologies

Course Outcomes:

1. Apply the concepts of AR and VR to various applications
2. Evaluate the various methodologies, and tools suitable for the development of AR and VR
3. Apply AR and VR application development using Unity software
4. Develop AR and VR applications using SDK bundles and deploy them in the head mount devices

Module:1	**Introduction to Virtual Reality**	**7 hours**
Introduction to virtual reality – history – design guidelines – How humans interact with computers – sensory design – sensory principle.		
Module:2	**Perceptual Models**	**7 hours**
Perceptual modalities – Space and Time – stability, attention, and action – design guidelines – adverse health effects - Content Creation – Interaction – VR components – present and future state of VR.		
Module:3	**Models and Mapping**	**6 hours**
Virtual reality for ART – 3D art optimization – hardware – SLAM – tracking – Mapping – Geometric modeling, kinematics modeling, physical modeling, behavior modeling - Platforms - 3D position tracking – navigation – position and motion tracking – data gloves, and gesture interface.		
Module:4	**Virtual Reality Devices**	**6 hours**
Head mount devices - Types of VR devices – Oculus Quest - OpenGL, real-time rendering – haptics gesture interfaces - hand & pose recognition.		
Module:5	**Introduction to Augmented Reality**	**6 hours**
Overview of AR concepts – Taxonomy - Types of AR – Technology issue - game engine - modeling - tracking – calibration - computer vision for AR.		
Module:6	**Technologies & Tools for Augmented Reality**	**6 hours**
Working of AR – hardware components – software components – contents - interactions – mobile AR – user experiences and interface - Tools for AR/VR development – OpenCV - ARKit – ARCore – cross-platform AR and VR - Virtual Reality Toolkit (VRTK) – Wikitude.		
Module:7	**Development and applications of AR/VR**	**5 hours**
Develop and deploy AR applications (Vuforia) - Develop and deploy VR applications – Software development kit Applications – Scientific, industrial and government – commercial and enterprise – Education – Healthcare.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**
	Total Tutorial hours:	**15 hours**

Text Book(s)

1.	Erin, Steve Lukas, Vasanth Mohan, Creating Augmented and Virtual Realities, Theory & Practice for Next Generation Spatial Computing,2019, O'reilly.
2	John Peddie, Augmented Reality, where we will live,2017 Springer.

Reference Books

1.	Jens Grubert, Raphael Grasset, "Augmented Reality for Mobile application development",2013 O'reilly
2.	Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR", 2016,Addison-Wesley professional.

3	Jason Gerald, “The VR Book, Human-centered design for Virtual Reality”,2016, ACM.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC411L	Blockchain Technologies	**3**	**1**	**0**	**4**
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand fundamental components of Blockchain technology and examine decentralization using blockchain
2. To examine the technical aspects of digital keys, mining, and crypto transaction in blockchain

3. To function the components of bitcoin and explore the real time blockchain applications

Course Outcomes:

1. Identify the technology components of Blockchain and different approaches to developing decentralized applications
2. Understand the cryptography fundamentals
3. Inspect Bitcoin and its transaction life cycle
4. Comprehend the operational aspects of mining and mining algorithms
5. Examine the use of alternative coins and real time applications of blockchain

Module:1	**Introduction to Blockchain Technology**	**6 hours**
The growth of blockchain technology- Distributed systems- The history of blockchain-Generic elements of a blockchain-Benefits and limitations of blockchain-Tiers of blockchain technology-Features of a blockchain-Types of blockchain-Consensus		
Module:2	**Decentralization**	**6 hours**
Decentralization using blockchain-Methods of decentralization-Routes to decentralization-Blockchain and full ecosystem decentralization-Decentralized Organizations-Platforms for decentralization		
Module:3	**Cryptography fundamentals**	**7 hours**
Introduction-Cryptographic Primitives-Symmetric Cryptography-Asymmetric Cryptography-Public and private keys-Hash functions		
Module:4	**Bitcoin Basics**	**7 hours**
Bitcoin-Digital keys and addresses-Transactions-The transaction life cycle-The transaction data structure-Types of transactions-The structure of a block-The structure of a block header-The genesis block		
Module:5	**Mining**	**6 hours**
Tasks of the miners-Mining Rewards-Proof of Work (PoW)- The mining algorithm-The hash rate-Mining Systems-Mining pools		
Module:6	**Alternative Coins and Smart Contracts**	**6 hours**
Theoretical foundations-Alternatives to Proof of Work-Various stake types-Name coin-Litecoin - Primecoin-Smart Contracts- History- Smart contract templates - Smart contract programming architecture		
Module:7	**Blockchain Applications**	**5 hours**
Blockchain in Supply Chain - Blockchain in Government - Internet of Things -Blockchain in Financial Service- Payments and Secure Trading - Compliance and Mortgage- Medical Record Management System - Identity Management - Property Records- smart cities, E-Governance		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**
	Total Tutorial Hours:	**15 hours**

Text Book(s)

1.	Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, 2018,Second Edition, Packt Publishing.

Reference Books

1.	Alexander Lipton ,Adrien Treccani ,“Blockchain and Distributed Ledgers Mathematics, Technology, and Economics” ,2021, world scientific publisher.
2.	Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”,2017, VPT.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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Course code	Course Title	L	T	P	C
UCSC412L	Malware Analysis	3	1	0	4
Pre-requisite		**Syllabus version**			
		V.1.0			

Course Objectives:

1. To understand and analyse malware using static and dynamic analysis
2. To examine malware behavior
3. To build and analyse malware networks and catch vulnerabilities by building your own malware network

Course Outcomes:

1. Understand the cyber security challenges raised from malicious software attacks
2. Analyze the security risks, threats and potential vulnerabilities on enterprise networks environment
3. Apply the learned techniques to protect, reduce the security risks and avoid malicious software attacks on computer systems or networks
4. Carry out independent analysis of modern malware samples using behavioral, code analysis and memory forensic techniques
5. Research independently and use learned skills and tools to investigate malicious software attacks and implement or update a cyber protection plan

Module:1	**Introduction of Malware**	**6 hours**
The cyber kill chain, Definition of malware and its role in the kill chain - Different types of malware , goal of malware analysis -Types of malware analysis - Setting up a safe environment for malware analysis		
Module:2	**Analyzing Malicious Windows Programs**	**6 hours**
The Portable Executable file format, PE header and sections, Windows loader, Windows API, Import Address Table, Import functions, Export functions - System architecture, processes, threads, memory management, registry , PE files on disk and in memory.		
Module:3	**Basic Static Analysis**	**6 hours**
Basic static analysis- concepts and tools: hash functions, VirusTotal, strings, PEiD, PE Explorer, CFF Explorer, and Resource Hacker-Identifying file obfuscation techniques: packers and cryptors - Introduction to Yara.		
Module:4	**Basic Dynamic and Network Analysis**	**7 hours**
Basic dynamic analysis - concepts and tools for: Sys-internals tools, sandboxes - Persistence techniques -Network analysis, Faking a network for safe malware analysis - Introduction to Wire shark - Command and Control communication of malware.		
Module:5	**Advanced Static Analysis**	**8 hours**
Introduction to x86 architecture - Memory, instructions, opcodes, operands, registers, functions, stack - source code, compiled code - Advanced static analysis - Introduction to disassemblers and decompilers - Static code analysis with IDA/Ghidra - Obfuscation techniques		
Module:6	**Advanced Dynamic Analysis**	**7 hours**
Introduction to debuggers - Dynamic analysis with OllyDbg - Process injection techniques and hooking - User mode, kernel mode debugging - Ransomware analysis, Cryptographic algorithms used by ransomware, Cryptographic flaws in ransomware		
Module:7	**Analysis of Malicious Documents and Malware Attacks**	**3 hours**
File formats: OLE2, OOXML, RTF, PDF - Malicious macro - Document exploits – OLE tools, Threat Intelligence, IOCs, Security solutions		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**
	Total Tutorial hours:	**15 hours**

Text Book(s)

1.	Alexey Kleymenov, Amr Thabet , “Mastering Malware Analysis: The complete malware analyst's guide to combating malicious software, APT, cybercrime, and IoT attacks”,2019, First Edition, Packt publishing

Reference Books

1.	Michael Sikorski, Andrew Honig ,”Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software”,2012, No Starch Press

2.	Michael Hale Ligh, Andrew Case, Jamie Levy, AAron Walters, “The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory”, 2014,Wiley		
3.	Monnappa K A , “Learning Malware Analysis: Explore the concepts, tools, and techniques to analyze and investigate Windows malware”, 2018 , Pakt Publisher		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

VIT
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CHENNAI

DISCIPLINE ELECTIVE COURSES

(Artificial Intelligence and Machine Learning)

Course Code	Course Title	L	T	P	C
UCSC311L	Artificial Intelligence	3	1	0	4
Pre-requisite		**Syllabus version**			
		1.0			
Course Objectives:					
1. To establish theoretical knowledge and understanding in the field of Artificial Intelligence and identify					

its possible applications 2. To familiarize oneself with AI techniques for problem-solving, planning and knowledge inference systems capability 3. To develop and design AI techniques to make decisions in complex uncertain environments		
Course Outcomes:		
1. Understand the foundation and applications of Artificial Intelligence 2. Use state space search and heuristic techniques for solving search problems 3. Apply randomized search and emergent systems for making decisions on complex problems 4. Use classical CSP techniques for selecting suitable actions to achieve a specific goal 5. Demonstrate the implications of planning and logics in artificial intelligence		
Module:1	**Introduction**	**5 hours**
Artificial Intelligence - Historical Backdrop - Mind and Body – AI in the Last Century - Applications of AI - The Turing Test – Intelligent Decision - The Bottom Line – Topics in AI		
Module:2	**State Space Search**	**6 hours**
Generate and Test- Simple Search – Depth First Search – Breadth First Search – Comparison of BFS and DFS – Quality of Solution – Depth Bounded DFS – Depth First Iterative Depending - Case Study: Water Jug Problem		
Module:3	**Heuristic Search**	**7 hours**
Heuristic Functions – Best First Search – Hill Climbing – Local Maxima – Solution Space Search – Variable Neighborhood Descent – Beam Search – Tabu Search – Peak to Peak Methods - Case Study: Traveling Salesman Problem		
Module:4	**Randomized Search and Emergent Systems**	**7 hours**
Iterated Hill Climbing – Simulated Annealing – Genetic Algorithms – The Travelling Salesman Problem – Neural Network – Emergent Systems – Ant Colony Optimization - Case Study: Knapsack Problem		
Module:5	**Constraint Satisfaction Problems**	**5 hours**
N – Queens – Constraint Propagation – Scene Labelling – Higher Order Consistency – Directional Consistency – Algorithm Backtracking – Look-Ahead Strategies – Strategic Retreat - Case Study: Map Coloring Problem		
Module:6	**Logic and Inferences**	**6 hours**
Formal Logic – Propositional Logic – Propositional Resolution – First Order Logic – Incompleteness - Forward Chaining – Resolution Refutation of FOL – Deductive Retrieval – Backward Chaining – Second Order Logic - Case Study: Machine Translations		
Module:7	**Planning**	**7 hours**
The STRIPS Domain – Forward State Space Planning - Backward State Space Planning – Goal Stack Planning – Plan Space Planning – A Unified Framework for Planning - Case Study: Robotic Arm problem		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours: **Tutorial Hours:**	**45 hours** **15 hours**
Text Book(s)		
1.	Deepak Khemani, “A First Course in Artificial Intelligence”, 2017, First Edition, McGraw Hill Education, India	
Reference Books		
1.	Stuart Russell and Peter Norvig,”Artificial Intelligence: A Modern Approach”, 2022, Fourth Edition, Pearson, India	
Mode of Evaluation: CAT, Written assignment, Quiz, FAT and Seminar		
Recommended by Board of Studies	01-11-2023	

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Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC312L	Machine Learning	3	0	0	3
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand the basic concepts of Machine Learning
2. To understand and build the supervised and unsupervised learning models
3. To learn and understand the concept of neural networks and deep learning

Course Outcomes:		
1. Identify the basic concepts of Machine Learning and Training model 2. Understand and distinguish between types of learning 3. Identify and apply the appropriate machine learning techniques for classification 4. Analyze the unsupervised learning techniques 5. Analyze the concept of Neural Network		
Module:1	**Introduction to Machine Learning**	**5 hours**
Fundamentals of Machine Learning – Applications -Types of Machine Learning – Challenges of Machine Learning – Testing and Validating		
Module:2	**Training a ML Model**	**5 hours**
End-to-End Machine Learning Project – Working with Real Data – Get the Data – Explore and Visualize the Data – Prepare the Data for Machine Learning Algorithms		
Module:3	**Classification and Regression**	**8 hours**
Support Vector Machine – Naive Bayes – Decision Tree – KNN algorithm - Regression – Linear Regression – Ridge Regression		
Module:4	**Ensemble Approaches**	**5 hours**
Voting Classifiers – Bagging and Pasting – Random Forests – Boosting – Stacking		
Module:5	**Dimensionality Reduction**	**5 hours**
Approaches for Deduction – Principal Component Analysis – Random Projection – Locally Linear Embedding		
Module:6	**Unsupervised Learning**	**7 hours**
K-means clustering - Limits of K-means – Hierarchical clustering- expected maximization algorithm		
Module:7	**Artificial Neural Network**	**8 hours**
Biological to Artificial Neurons – Logic Computations with Neurons – Perceptron - Multilayer Perceptron and Back propagation		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Aurelien Geron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow”, 2019, Second Edition,O'Reilly Media, Inc.
2.	Ethem Alpaydin, “Introduction to Machine Learning”, 2020, Fourth Edition, , MIT Press.
Reference Books	
1.	Aurélien Géron, “Neural networks and deep learning “,2018, O'Reilly Media.

Mode of Evaluation: CAT, Written assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC312P	Machine Learning Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					
1. To equip students with the knowledge about machine learning algorithms 2. To provide experience in applying machine learning algorithms to practical problems.					
Course Outcomes:					
1. Use appropriate algorithms for problem solving					

2. Understand complexity of Machine Learning algorithms and their limitations
3. Capable of performing experiments in Machine Learning using real-world data.

	Indicative Experiments	Hours
1.	**Python Libraries** Implementation of python libraries such as NumPy, Math and SciPy. Develop a python program to create a NumPy array and apply the matrix operations Develop a python program to create pandas data frame from list of data. Develop a python program to analyze the dataset using pandas and matplotlib library Develop a program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets.	4 Hours
2	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file	2 Hours
3	Develop a python program to implement Simple linear regression and plot the graph	3 Hours
3.	Develop a python program to classify the English text using Naïve baye's theorem	3 Hours
4.	Develop a python program to implement single layer perceptron. Implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	4 Hours
5.	Demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	2 Hours
6.	Implement the basic Averaging method & Max Voting ensemble methods to focus on classification problem.	2 Hours
7.	Implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.	2 Hours
8.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.	2 Hours
9.	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	2 Hours
10.	Mini project – develop a simple application using TensorFlow / keras	4 Hours
	Total Laboratory Hours	**30 hours**

Book(s)

1. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2019, Second Edition,O'Reilly Media, Inc.
2. Ethem Alpaydin, "Introduction to Machine Learning", 2020, Fourth Edition, , MIT Press

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC313L	Image Processing	3	0	0	3
Pre-requisite		**Syllabus version**			
Course Objectives:					
1. To understand and analyze the fundamental principles of digital image processing. 2. To apply image enhancement, and restoration techniques. 3. To demonstrate the image segmentation and morphological operations					
Course Outcomes:					

Text Book(s)				
1. Rafel C Gonzalez, Richard E Woods, "Digital Image Processing",2018, Fourth Edition - Wesley Publishing Company				
Reference Books				
1.	S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", 2019, MC Graw Hill Education Pvt. Ltd			
2.	Anil K Jain, "Fundamentals of Digital Image Processing", 2015, Prentice Hall of India			
3.	William K. Pratt, "Digital Image Processing", 2014, John Wiley & Sons			
Mode of Evaluation: CAT, Written assignment, Quiz, FAT and Seminar				
Recommended by the Board of Studies	01-11-2023			
Approved by Academic Council	No. 72	Date	13-12-2023	

1. Interpret the fundamental concepts of a digital image processing system.
2. Analyze images in spatial and frequency domains using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Apply thresholding and region-based image segmentation techniques
5. Demonstrate the geometrical structures of an image using morphological processing

Module:1	**Digital Image Fundamentals**	**5 Hours**
Origins of digital image processing – Examples of Fields that use Digital Image Processing – Fundamental Steps in Digital Image Processing- Components of an Image Processing Systems		
Module:2	**Sampling And Quantization**	**6 Hours**
Image Sampling and Quantization, Representing Digital Images, Spatial and Intensity Resolution, and Image Interpolation- The basic relationship between pixels		
Module:3	**Spatial domain image enhancement**	**6 Hours**
Intensity Transformation Functions - Histogram Processing – Spatial Filtering, Spatial Correlation and Convolution- Smoothing and Sharpening of Spatial Filters		
Module:4	**Frequency Domain Image Enhancement**	**7 Hours**
Introduction to transforms, 2D Discrete Fourier Transform and its properties - Filtering in Frequency Domain - Image Smoothing - Image Sharpening		
Module:5	**Image Restoration**	**7 Hours**
Model of Image Degradation / Restoration - Noise models – Restoration in the Presence of Noise through Spatial Filtering: Mean Filter, Order Statistic Filter, Adaptive Filter - Periodic Noise Reduction by Frequency Domain Filtering		
Module:6	**Image Segmentation**	**6 Hours**
Point, Line and Edge Detections - Thresholding – Region Based Segmentation: Region Growing, Region Splitting and Merging		
Module 7	**Morphological Processing**	**6 Hours**
Morphological operations- Erosion, Dilation, Opening and Closing, Applications of morphological processing		
Module 8	**Contemporary Topics**	**2 Hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 Hours**

Course Code	Course Title	L	T	P	C
UCSC313P	Image Processing Lab	0	0	2	1
Pre-requisite		**Syllabus Version**			

		1.0

Course Objectives:

1. To present a clear exposition of image smoothing and sharpening techniques
2. To provide the knowledge of image restoration techniques and morphological operations

Course Outcomes:

1. Understand the fundamentals of digital image processing and image transform techniques
2. Apply different Image Smoothening & Sharpening algorithms in spatial and frequency domains
3. Analyze the threshold and edge based image segmentation and morphological processing

Indicative Experiments		Hours
1.	Basic matrix operations on image	3 Hours
2.	Implementation of point process techniques	3 Hours
3.	Implementation of spatial domain smoothing and sharpening techniques	3 Hours
4.	Implementation of DFT and inverse DFT techniques	3 Hours
5.	Implementation of frequency domain smoothing and sharpening techniques	3 Hours
6.	Implementation of spatial domain restoration techniques	3 Hours
7.	Implementation of frequency domain restoration techniques	3 Hours
8.	Implementation of Image segmentation using point line and edge detection approach	3 Hours
9.	Implementation of threshold based segmentation	3 Hours
10.	Boundary extraction using morphological operations	3 Hours
	Total Laboratory Hours	**30 Hours**

Text Book(s)

1.	Rafael.C,Gonzalez, Richard E Woods, "Digital Image Processing",2018,Fourth Edition, Pearson.
2.	S Jayaraman , S Esakkirajan, T Veerakumar, "Digital Image Processing" , 2019, MC Graw Hill Education

Mode of assessment: CAT, Exercises, FAT

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UCSC314L	Deep Learning	3	0	0	3
Pre-requisite		**Syllabus version**			

		v.1.0

Course Objectives:

1. To learn the basics of deep learning and the learning strategies in deep neural networks
2. To acquire knowledge on the concepts of Convolutional Neural Networks and recurrent networks along with their applications
3. To apply Deep Learning techniques to solve various real-world problems

Course Outcomes:

1. Familiarize the basic concepts of learning algorithms and the significance of deep learning
2. Understand the process of regularization and optimization methods for deep neural networks
3. Construct the convolutional neural networks with appropriate building blocks
4. Recognize the architecture of recurrent neural networks for solving time series problems
5. Explore the concepts of modern practical deep networks to solve real-world problems

Module:1	**Artificial Neural Network**	**7 hours**
Basic concepts of Artificial Neurons,MP Neurons, Single and Multi-layer Perceptron, Perceptron learning algorithm, Feed-Forward Neural network - Types of Learning Algorithms: Supervised and Unsupervised algorithms, Significance of Deep Learning, Applications		
Module:2	**Deep Feedforward Networks**	**7 hours**
Gradient-Based Learning-Hidden Units-Architecture Design-Back-Propagation and Other Differentiation Algorithms		
Module:3	**Regularization**	**4 hours**
Parameter Norm Penalties: Parameter Regularization, L1 Regularization - Constrained Optimization using Norm Penalties - Early Stopping – Dropout		
Module:4	**Convolutional Networks**	**7 hours**
Convolution Operation - Pooling – Convolution and Pooling as an Infinitely Strong Prior - Variants of the Basic Convolution Function		
Module:5	**Auto Encoders**	**4 hours**
Undercomplete Autoencoders - Regularized Autoencoders - Stochastic Encoders and Decoders - Applications of Autoencoders		
Module:6	**Sequence Models: Recurrent Nets**	**7 hours**
Unfolding Computational Graphs - Recurrent Neural Networks – Deep Recurrent Networks – Recursive Neural Networks-Long Short-Term Memory and Other Gated RNNs		
Module:7	**Practical Methodologies and Applications**	**7 hours**
Performance Metrics-Default Baseline Models - Selecting Hyperparameters- Debugging Strategies-Large-Scale Deep Learning - Speech Recognition		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep learning”, 2016, MIT Press

Reference Books

1.	Dipanjan Sarkar, Raghav Bali, Tamoghna Ghosh, Hands-On Transfer Learning with Python, 2018, First edition, Packt Publishing
2.	John D. Kelleher, Deep Learning, 2019, First edition, The MIT Press
3.	Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, 2018, First Edition, Springer

Mode of Evaluation: CAT, Written assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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Course Code	Course Title	L	T	P	C
UCSC314P	Deep Learning Lab	0	0	2	1
Pre-requisite		**Syllabus version**			

		V.1.0

Course Objectives:

1. To understand the basics of learning strategies, optimization and regularization techniques in deep neural networks
2. To apply Deep Learning techniques to solve various real-world problems

Course Outcomes:

1. Familiarize the basic concepts of learning algorithms and artificial neural networks
2. Understand the process of regularization and optimization methods for deep neural networks
3. Construct the convolutional neural networks and recurrent neural networks for solving real-world problems

	Indicative Experiments	**Hours**
1.	Implementation of Simple Neural Network	3 Hours
2.	XOR implementation using Neural Networks	3 Hours
3.	Implementation of neural networks with regularization and fine-tuning techniques	3 Hours
4.	Usage of Back Propagation neural network for classification problems	3 Hours
5.	Implementation of different auto-encoders	3 Hours
6.	Implementation of CNN for image-based datasets	3 Hours
7.	Implementation of CNN for other applications	3 Hours
8.	Implementation of a simple Recurrent Neural Network	3 Hours
9.	Implementation of a LSTM and BLSTM for a specific application	3 Hours
10.	Implementation of a GRU and BGRU for a specific application	3 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep learning, 2016, MIT Press

Reference Books

1.	Dipanjan Sarkar, Raghav Bali, Tamoghna Ghosh, Hands-On Transfer Learning with Python, 2018, First edition, Packt Publishing
2.	John D. Kelleher, Deep Learning, 2019, First edition, The MIT Press

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course code	**Course Title**	**L**	**T**	**P**	**C**
UCSC315L	Human Computer Interaction	3	1	0	4
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To introduce the concepts that are necessary to produce effective interface designs.
2. To gain knowledge about development methodologies, evaluation techniques, task analysis, and prototyping.
3. To understand the conceptual frameworks for cognition, communication and collaboration.

Course Outcome

1. Understand human computer interaction principles, requirements and cognition frameworks
2. Summarize the concepts of collaborative and interaction design process
3. Understand the prototyping techniques and guidelines for the conceptual and physical design
4. Analyze the evaluation paradigms and framework for coherence and contextual design process.
5. Create the predictive models to design mobile communicators

Module:1	**Introduction to Interaction**	**5 hours**
Interaction design: Good and Poor design, Process of interaction design; Goals: Usability, and User experience goals; Heuristics and usability principles- Nielsen's Heuristics		
Module:2	**Conceptualization and Cognition**	**6 hours**
Conceptual models - Conceptual models based on activities - Conceptual models based on objects- Interface metaphors- Paradigms of interaction- Conceptual frameworks for cognition: Mental models, Information processing, External Cognition		
Module:3	**Designing for collaboration and communication**	**6 hours**
Social mechanisms used in communication and collaboration: Conversational mechanisms, Coordination mechanisms, Awareness mechanisms- Interaction design and lifecycle models		
Module:4	**Identifying needs and establishing requirements**	**6 hours**
Requirements, Data gathering, Data interpretation and analysis, Task description and analysis: Scenarios, Use cases, Hierarchical Task Analysis (HTA)		
Module:5	**Design, prototyping and construction**	**7 hours**
Low fidelity and high fidelity prototyping, compromises in prototyping, Conceptual design and Physical design- Guidelines for physical design - Shneiderman's eight golden rules of interface design		
Module:6	**User-centered approaches, Evaluation Framework**	**7 hours**
Introduction, Coherence and Contextual design, Participatory design: PICTIVE and CARD; Evaluation paradigms and Techniques, DECIDE: Framework for evaluation		
Module:7	**Testing, modeling users, Design and Evaluation**	**6 hours**
User testing, predictive models; Designing mobile communicators: Nokia's approach to developing a communicator, Philip's approach to designing a communicator for children		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**
	Total Tutorial hours:	**15 hours**

Text Book(s)

1. Helen Sharp, Jennifer Preece, Yvonne Rogers, “Interaction Design: Beyond Human-Computer Interaction”, 2019,Fifth edition, Wiley.

Reference Books

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”,2016 Sixth edition, Pearson.

Mode of Evaluation: CAT, Written assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UBSC316L	Computer Vision	3	1	0	4
Pre-requisite		**Syllabus version**			
		v.1.0			

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Course Objectives		
1. To identify major image analysis approaches involved in computer vision 2. To understand concepts of image formation, feature extraction and image analysis 3. To emphasize both the theoretical and practical aspects of computing with images		
Course Outcome		
1. Understand key concepts related to Image formation and processing 2. Comprehend techniques in Recognition, feature detection and matching 3. Interpret significant methods in motion estimation 4. Recognize basic skills to reconstruct 3D images 5. Understand concepts in image-based rendering		
Module:1	**Introduction and Image Formation**	**5 hours**
Computer Vision – Geometric primitives and transformation – Photometric Image Formation – The digital camera		
Module:2	**Image Processing**	**5 hours**
Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Geometric transformations		
Module:3	**Recognition**	**7 hours**
Instance recognition-Image Classification - Object detection- Semantic segmentation – Video Understanding		
Module:4	**Feature Detection and Matching**	**7 hours**
Points and Patches - Edges and Contours - Lines and Vanishing Points -Segmentation		
Module:5	**Motion Estimation**	**6 hours**
Translational alignment - Parametric motion - Optical flow - Layered motion		
Module:6	**3D Reconstruction**	**6 hours**
Shape from X – 3D Scanning - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction		
Module:7	**Image-based rendering**	**7 hours**
View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes - Video-based rendering		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours: **Total Tutorial hours:**	**45 hours** **15 hours**

Text Book(s)	
1.	R. Szeliki, “Computer Vision: Computer Vision: Algorithms and Applications”, 2021, Second edition, Springer-Verlag London Limited
Reference Books	
1.	D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, 2015, Second edition, Pearson Education
2.	S. Khan, H. Rahmani, S. Shah and M. Bennamoun, “A Guide to Convolutional Neural Networks for Computer Vision”, 2018, First edition, Morgan & Claypool Publishers, Australia

Mode of Evaluation: CAT, Written assignment, Quiz, FAT and Seminar			
Recommended by	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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DISCIPLINE ELECTIVE COURSES

(Data Science)

Course Code	Course Title	L	T	P	C
UCSC312L	Machine Learning	3	0	0	3
Pre-requisite		**Syllabus version**			

		v.1.0

Course Objectives:

1. To understand the basic concepts of Machine Learning
2. To understand and build the supervised and unsupervised learning models
3. To learn and understand the concept of neural networks and deep learning

Course Outcomes:

1. Identify the basic concepts of Machine Learning and Training model
2. Understand and distinguish between types of learning
3. Identify and apply the appropriate machine learning techniques for classification
4. Analyze the unsupervised learning techniques
5. Analyze the concept of Neural Network

Module:1	**Introduction to Machine Learning**	**5 hours**
Fundamentals of Machine Learning – Applications -Types of Machine Learning – Challenges of Machine Learning – Testing and Validating		
Module:2	**Training a ML Model**	**5 hours**
End-to-End Machine Learning Project – Working with Real Data – Get the Data – Explore and Visualize the Data – Prepare the Data for Machine Learning Algorithms		
Module:3	**Classification and Regression**	**8 hours**
Support Vector Machine – Naive Bayes – Decision Tree – KNN algorithm - Regression – Linear Regression – Ridge Regression		
Module:4	**Ensemble Approaches**	**5 hours**
Voting Classifiers – Bagging and Pasting – Random Forests – Boosting – Stacking		
Module:5	**Dimensionality Reduction**	**5 hours**
Approaches for Deduction – Principal Component Analysis – Random Projection – Locally Linear Embedding		
Module:6	**Unsupervised Learning**	**7 hours**
K-means clustering - Limits of K-means – Hierarchical clustering- expected maximization algorithm		
Module:7	**Artificial Neural Network**	**8 hours**
Biological to Artificial Neurons – Logic Computations with Neurons – Perceptron - Multilayer Perceptron and Back propagation		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Aurelien Geron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow”, 2019, Second Edition, O'Reilly Media Inc
2. Ethem Alpaydin, “Introduction to Machine Learning”, 2020, Fourth Edition, , MIT Press.

Reference Books

1. Aurélien Géron, “Neural networks and deep learning “,2018, O'Reilly Media.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UCSC312P	Machine Learning Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To equip students with the knowledge about machine learning algorithms
2. To provide experience in applying machine learning algorithms to practical problems.

Course Outcomes:		
1. Use appropriate algorithms for problem solving 2. Understand complexity of Machine Learning algorithms and their limitations 3. Capable of performing experiments in Machine Learning using real-world data		
	Indicative Experiments	**Hours**
1.	**Python Libraries** Implementation of python libraries such as NumPy, Math and SciPy. Develop a python program to create a NumPy array and apply the matrix operations Develop a python program to create pandas data frame from list of data. Develop a python program to analyze the dataset using pandas and matplotlib library Develop a program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets.	4 Hours
2	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file	2 Hours
3	Develop a python program to implement Simple linear regression and plot the graph	3 Hours
3.	Develop a python program to classify the English text using Naïve baye's theorem	3 Hours
4.	Develop a python program to implement single layer perceptron. Implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	4 Hours
5.	Demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	2 Hours
6.	Implement the basic Averaging method & Max Voting ensemble methods to focus on classification problem.	2 Hours
7.	Implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.	2 Hours
8.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.	2 Hours
9.	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	2 Hours
10.	Mini project – develop a simple application using TensorFlow / keras	4 Hours
	Total Laboratory Hours	**30 hours**
Book(s)		
1. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2019, Second Edition,O'Reilly Media Inc 2. Ethem Alpaydin, "Introduction to Machine Learning", 2020, Fourth Edition, MIT Press		
Mode of assessment: CAT, Exercises, FAT		
Recommended by Board of Studies	01-11-2023	
Approved by Academic Council	No. 72	Date 13-12-2023

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Course Code	Course Title	L	T	P	C
UCSC317L	Big Data Technologies	3	0	0	3
Pre-Requisite		**Syllabus version**			
		1.0			
Course Objectives:					

1. To understand the basics of Big Data and its analytics methods
2. To provide an overview of Apache Hadoop and its Eco System
3. To analyze unstructured data using appropriate tools and technologies

Course Outcomes:

1. Identify big data systems and design for analysis
2. Understand the Hadoop Eco System and Mapreduce framework
3. Analyze different types of data stored in Hadoop for decision making
4. Apply Hadoop related tools and understand the YARN architecture
5. Create and Process data using Spark and NoSQL

Module:1	**Introduction to Big Data Concepts**	**5 hours**
Evolution of Big data – Structuring Big data, Elements of Big data, Different Types of Analytics – Exploring the use of Big Data		
Module:2	**Understanding Hadoop Eco system**	**5 hours**
Introduction to Hadoop, Terminologies; Hadoop Distributed File System - MapReduce, Hadoop YARN, Hbase, Hive - Pig and Pig Latin, Sqoop, ZooKeeper - Flume, Oozie		
Module:3	**MapReduce Framework**	**6 hours**
The MapReduce Framework - Techniques to Optimize MapReduce Jobs - Uses of MapReduce - Role of HBase in Big Data Processing - Exploring the Big Data Stack - Virtualization and Big Data - Virtualization Approaches		
Module:4	**Hadoop Database**	**6 hours**
RDBMS and Big Data - Non-Relational Database, Polyglot Persistence - Integrating Big Data with Traditional Data Warehouses - Big Data Analysis and Data Warehouse - Selecting the Suitable Hadoop Data Organization for Applications		
Module:5	**Understanding Hadoop YARN**	**7 hours**
Background of YARN, Advantages of YARN - YARN Architecture, Working of YARN - YARN Schedulers - Backward Compatibility with YARN - YARN Configurations, YARN Commands - Log Management in Hadoop 1 - Advantages of YARN		
Module:6	**Hadoop Related tools**	**8 hours**
Introducing Pig, Running Pig - Getting Started with Pig Latin - Working with Operators in Pig - Working with Functions in Pig - Using Oozie - Introducing Oozie - Oozie Coordinator, Oozie Bundle - Oozie Parameterization with EL - Oozie Job Execution Model - Accessing Oozie, Oozie SLA		
Module:7	**No SQL Data Management**	**6 hours**
Introduction to NoSQL, Aggregate Data Models - Key Value Data Model, Document Databases - Relationships, Graph Databases - Schema-Less Databases, Materialized Views - Distribution Models, Sharding - MapReduce Partitioning and Combining - Composing MapReduce Calculations		
Module:8	**Contemporary Issues**	**2hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	DT Editorial Services, “Big Data (covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visulization) Black Book” 2017, Dreamtech Press.

Reference Books

1.	Raj Kamal, Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning" , 2019, McGraw-Hill Education
2.	Paul Zikopoulos, Chris Eaton, Dirk Deroos, Tom Deutsch, " Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data",2017, McGraw-Hill Education

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies			
Approved by Academic Council		Date	

Course Code	Course Title	L	T	P	C
UCSC317P	Big Data Technologies Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			
Course Objectives:					
1. To analyze unstructured data using appropriate tools and technologies 2. To develop R programs for data stored in HDFS					
Course Outcomes:					
1. Apply MapReduce based analysis					

2. Create and Process data using Spark and NoSQL 3. Develop R programs for analysis and visualization with data stored in HDFS		
Indicative Experiments		**Hours**
1.	Use different HDFS commands	2 Hours
2	File R/W programs	2 Hours
3.	Programs using MapReduce Paradigm (Word count, Matrix Multiplication).	6 Hours
4.	Creating Hive database and applying queries	4 Hours
5.	Creating Hbase database and applying queries	4 Hours
6.	Writing SparkQL queries	4 Hours
7.	Visualizing data using R with different types of graphs and charts	4 Hours
8.	Importing data from csv, xls files and HDFS and analyzing	4 Hours
	Total Laboratory Hours	**30 hours**
Text Book(s)		
1	DT Editorial Services, “Big Data (covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visulization) Black Book” 2017, Dreamtech Press.	
Reference Book(s)		
1	Raj Kamal, Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning",2019, McGraw-Hill Education.	
2	Paul Zikopoulos, Chris Eaton, Dirk Deroos, Tom Deutsch, " Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data",2017, McGraw-Hill Education	

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UCSC318L	**Exploratory Data Analytics**	**3**	**0**	**0**	**3**
Pre-requisite		**Syllabus version**			
		V.1.0			

Course Objectives:

1. To explore the data using various tools
2. To visualize and transform data
3. To analyze and evaluate data using statistical methods

Course Outcomes:		
1. Explore and analyze data using various tools 2. Visualize and transform data using charts and frames 3. Gain knowledge in correlation and time-series analysis 4. Able to apply techniques for handling multi-dimensional data 5. Analyze the suitable exploratory data analysis methods in machine learning applications		
Module: 1	**Introduction to Data Analytics and Exploratory Data Analysis**	**4 hours**
Understanding data science -The significance of EDA-Making sense of data-Comparing EDA with classical and Bayesian analysis-Software tools available for EDA		
Module: 2	**Visual Aids for EDA**	**7 hours**
Technical requirements - Bar charts - Scatter plot- Area plot and stacked plot - Pie chart - Table chart - Polar chart – Histogram - Lollipop chart		
Module: 3	**Data Transformation**	**7 hours**
Loading the dataset - Data transformation - Data analysis -Merging database-style dataframes - Transformation techniques		
Module: 4	**Descriptive Statistics**	**7 hours**
Technical requirements- Understanding statistics - Measures of central tendency - Measures of dispersion - Grouping Datasets		
Module: 5	**Correlation Analysis and Time Series Analysis**	**6 hours**
Types of analysis: Understanding univariate, bivariate, multivariate analysis - Understanding the time series dataset - TSA with Open Power System Data		
Module: 6	**Hypothesis Testing and Regression**	**6 hours**
Hypothesis testing principle - Types of Hypothesis testing - T-test - p-hacking - Understanding regression		
Module: 7	**Model Development and Evaluation**	**6 hours**
Types of machine learning - Understanding supervised learning - Understanding unsupervised learning - Understanding reinforcement learning - Unified machine learning workflow		
Module: 8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python” First Edition, 2020, Packt Publishing.
Reference Books	
1.	Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 2019, O’Reilly.
2.	Craig K. Enders, “Applied Missing Data Analysis”, Second Edition, 2022, Guilford Press

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

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Course Code	Course Title	L	T	P	C
UCSC318P	Exploratory Data Analytics Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		1.0			
Course Objectives:					
1. To emphasize the importance of programming in EDA 2. To familiarize the student with Python programming for various tasks					
Course Outcomes:					

1. Gain practical knowledge on various methods to handle missing data 2. Identify the suitable plots for data and conclude the characteristics of the data 3. Explore the importance of exploratory data analysis in machine learning practically		
Indicative Experiments		**Hours**
1.	Practical exercises on data transformation and pre-processing methods.	2 Hours
2.	Practical exercises on missing data methods, imputation methods, multiple imputation	2 Hours
3	Practical exercises on displaying plots of categorical data.	2 Hours
4	Practical exercises on displaying plots of numerical data.	2 Hours
5	Practical exercises on displaying plots of frequency distribution.	2 Hours
6	Practical exercises on displaying plots of bivariate numerical data.	2 Hours
7.	Practical exercises on uniform distribution, normal distribution, binomial distribution	2 Hours
8.	Practical exercises on a measure of central tendency: mean, median, mode, standard deviation.	2 Hours
9	Practical exercises on univariate, bivariate, and multivariate analysis	2 Hours
10	Practical exercises on measure dispersion.	2 Hours
11.	Practical exercises on correlation analysis	2 Hours
12.	Practical exercises on time series analysis	2 Hours
13.	Practical exercises on plotting of clusters using k-means	2 Hours
14	Practical exercises on word cloud	2 Hours
15.	Practical exercises on regression	2 Hours
	Total Laboratory Hours	**30 hours**
Text Book(s)		
1.	Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, 2020, First Edition, Packt Publishing	
Reference Books		
1.	Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 2019, O’Reilly	
2	Danyel Fisher and Miriah Meyer “Making Data Visual: A Practical Guide to Using Visualization for Insight”, 2018, O’Reilly	

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 72	Date	13-12-2023

Course code	**Course Title**	**L**	**T**	**P**	**C**
UCSC319L	**Data Visualization**	**3**	**1**	**0**	**4**
Pre-requisite		**Syllabus version**			
		1.0			
Course Objectives :					
1. To understand the various types of data, and apply and evaluate the principles of data visualization 2. Acquire skills to apply a structured approach and visualization techniques to create visualizations					

for a problem effectively and its associated dataset
3. To create interactive visualization for better insight using various visualization tools

Course Outcomes:

1. Identify the different data, and visualization types to bring out the insight
2. Relate the visualization to the problem based on the dataset to analyze and bring valuable insight from a large dataset
3. Design visualization dashboards and reports to support decision-making on large-scale data
4. Demonstrate the analysis of the large dataset using various visualization techniques and tools
5. Handle data and data visualizations in a manner that demonstrates an understanding of ethical considerations surrounding data

Module:1	**Introduction to Data Visualization**	**6 hours**
Data Visualization and its Importance – Overview of data visualization - From Graphics to Visualization- Graphics-Rendering Basics- Rendering the Height Plot- Texture Mapping- Transparency and Blending- Viewing		
Module:2	**Data Representation and Visualization Pipeline**	**7 hours**
Continuous Data - Discrete Datasets - Cell Types - Grid Types - Attributes - Advanced Data Representation - Conceptual Perspective - Implementation Perspective - Algorithm Classification		
Module:3	**Scalar and vector Visualization**	**6 hours**
Color Mapping - Designing Effective Colormaps – Contouring - Height Plots - Divergence and Vorticity - Vector Glyphs - Vector Color Coding - Displacement Plots - Stream Objects - Texture-Based Vector Visualization		
Module:4	**Tensor Visualization**	**7 hours**
Principal Component Analysis - Visualizing Components - Visualizing Scalar and vector PCA Information - Tensor Glyphs - Fiber Tracking - Fiber Rendering – Hyperstreamlines		
Module:5	**Domain-Modeling Techniques**	**6 hours**
Cutting – Selection - Grid Construction from Scattered Points - Grid-Processing Techniques		
Module:6	**Image and Volume Visualization**	**6 hours**
Image Data Representation - Image Processing and Visualization - Basic Imaging Algorithms - Shape Representation and Analysis - Volume Visualization Basics - Image Order Techniques - Object Order Techniques - Volume Rendering vs. Geometric Rendering		
Module:7	**Information Visualization and Software**	**5 hours**
Infovis vs. Scivis - Table Visualization - Visualization of Relations - Multivariate Data Visualization - Text Visualization - Imaging Software - Grid Processing Software - Information Visualization Software		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**
	Total Tutorial hours:	**15 hours**

Text Book(s)

1.	Tamara Munzer, “Visualization Analysis and Design”, First edition, 2015, CRC Press.

Reference Books

1.	Ossama Embarak, “Data Analysis and Visualization Using Python Analyze Data to Create Visualizations for BI Systems”, 2018, APress.
2.	Michael Fry, Jeffrey Ohlmann, Jeffrey Camm, James Cochran, ”Data Visualization: Exploring and Explaining with Data”, 2021, South-Western College Publishing.
3.	Avril Coghlan, “A little book of R for multivariate analysis”, First edition, 2013, Welcome Trust Sanger Institute

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	01-11-2023

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Approved by Academic Council	No. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC320L	NoSQL Databases	3	0	0	3
Pre-requisite		Syllabus version			
		1.0			
Course Objectives:					
1. To explore the basics of NoSQL databases					

2. To describe the main types of NoSQL databases and their architectures 3. To facilitate the students to choose correct type of NoSQL depends on the application requirements		
Course Outcomes:		
1. Explore distributed data processing and distributed databases 2. Understand the detailed architecture of NoSQL and its major types 3. Employ Key Data store and document data store in real time applications 4. Apply Columnar Data store as a backend for suitable applications 5. Explore Neo4J for graphical applications		
Module:1	**Introduction to NoSQL Concepts**	**5 hours**
The Value of Relational Databases - Impedance Mismatch - Application and Integration Databases - Attack of the Clusters - The Emergence of NoSQL		
Module:2	**Aggregate and Distribution Models**	**7 hours**
Aggregates -Key-Value and Document Data Models - Column-Family Stores – Relationships - Graph Databases - Schemaless Databases - Materialized Views - Modeling for Data Access - Single Server – Sharding – Master Slave Replication - Peer-to-Peer Replication - Combining Sharding and Replication		
Module:3	**Consistency and Version Stamps**	**6 hours**
Update – Read – Relaxing Consistency - Relaxing Durability – Quorums - Business and System Transactions - Version Stamps on Multiple Nodes – Mapreduce		
Module:4	**Key-Value and Document Databases**	**6 hours**
Key-Value Data Store - Features - Suitable Use Cases- - Document Database: Features - Suitable Use Cases		
Module:5	**Column-Family Stores and Graph Databases**	**6 hours**
Column-Family Data Store: Features-Suitable Use Cases - Graph Database- Features-Suitable Use Cases		
Module:6	**Schema Migrations and Polyglot Persistence**	**7 hours**
Schema Changes -Schema Changes in RDBMS - Schema Changes in a NoSQL Data Store - Disparate Data Storage Needs - Polyglot Data Store Usage - Service Usage over Direct Data Store Usage - Expanding for Better Functionality - Choosing the Right Technology- Enterprise Concerns with Polyglot Persistence- Deployment Complexity		
Module:7	**Beyond NoSQL**	**6 hours**
File Systems - Event Sourcing - Memory Image - Version Control - XML Databases - Object Databases-visualize relation -Choosing Your Database - arangodb		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Pramod J. Sadalage and Martin Fowler, "**NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence"**, 2019, Addison Wesley	
Reference Books		
1.	Jeff Carpenter, Eben Hewitt **, "**Cassandra: The Definitive Guide", 2020,Third Edition, O'Reilly Media, Inc	
2	Daniel G. McCreary and Ann M. Kelly, "Making Sense of NoSQL", 2013, Manning publisher	

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
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Course Code	Course Title	L	T	P	C
UCSC320P	NoSQL Databases Lab	0	0	2	1
Pre-requisite		Syllabus version			
		1.0			
Course Objectives:					
1. To explore the basics of NoSQL databases and the difference between the NoSQL database					

and Traditional relational DBMS.

2. To describe the main types of NoSQL databases and their architectures.
3. To facilitate the students to choose the correct type of NoSQL based on the application requirements

Course Outcomes:

1. Able to design appropriate data store using MongoDB and perform CRUD operations and queries
2. Apply Cassandra Datastore for real-time applications to do analysis using CRUD and query operations.
3. Exposure to Neo4J and ability to solve graphical processing applications

Indicative Experiments		**Hours**
1.	Redis Commands	2 Hours
2.	Simulation of session variables and values using Redis Commands	2 Hours
3.	MongoDB CRUD operations for simple and collection data types	2 Hours
4.	Mongo DB indexing and queries	3 Hours
5.	MongoDB with Java or Python	3 Hours
6.	Cassandra CRUD operations for all data types	3 Hours
7.	Cassandra indexing, queries	3 Hours
8.	Cassandra with java or Python	3 Hours
9.	Neo4J Node and relationship creations	3 Hours
10	Queries with Neo4J	2 Hours
11	Queries with Neo4j	2 Hours
12	Neo4j with Java or Python	2 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Pramod J. Sadalage and Martin Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 2019, Addison Wesley

Reference Books

1.	Kristina Chodorow, “Mongo DB the Definitive Guide”, 2013, O’Reilly Media.
2.	Jeff Carpenter, Eben Hewitt, “Cassandra: The Definitive Guide”, Third Edition, 2020, O'Reilly Media, Inc.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	01-11-2023		
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Course Code	Course Title	L	T	P	C
UCSC321L	Social Network Analytics	3	1	0	4
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To understand the insights and components of Social Network
2. To analyze network measures and link predictions
3. To apply the concept of community structure, detection, and prediction in social networks

Course Outcomes:

1. Understand the social network analysis and its applications
2. Analyze the importance of nodes in a network and find the dependencies among the nodes using views of network models
3. Evaluate a social network using different measures and metrics
4. Analyze the different link analysis algorithms and link prediction methods in social network applications
5. Develop social network applications for different types of communities

Module:1	Introduction to Social Network Analysis	4 hours

Social Network Analysis - Need for Social Networks - Applications of Social Network Analysis – Healthcare – Social Media & E-Commerce – Web and Cyberspace – Police & Military – Scientific Research & Academic Collaboration – Graphical Representation

Module:2	Networks, View, and its Applications	5 hours

Networks – Types of Networks – Link-centric view - Combining Node-centric and Link-centric view – Local view – Temporal View – Generalized Views – Popular Real World Network - Three Levels of Social Network Analysis - Historical Development - From Sociology to Sociometry - Applications of Graph Theory to Social Structures - Social Network as Complex Network - Role of Computers in Influencing Social Network Analysis - Graph Visualization Tools

Module:3	Network Measures	6 hours

Network Measures - Network Basics - Degree and Degree Distributions – Paths - Clustering Coefficient - Connected Components - Node Centrality – Assortativity - Transitivity and Reciprocity – Similarity – Degeneracy

Module:4	Network Growth Models	7 hours

Properties of Real-World - High Average Local Clustering Coefficient -Small-world Property - Scale-free Property Networks – Random Network Model - Degree Distribution of Random Network - Binomial to Poisson Distribution - Evolution of a Random Network - Average Path Length - Clustering Coefficient - Random Network vs. Real-world Network – Ring Lattice Network Model – Watts Stragatz Model – Preferential Attachment model – Price's Model

Module:5	Link Analysis	7 hours

Applications of Link Analysis - Signed Networks - Strong and Weak Ties - Link Analysis Algorithms – PageRank - Personalised PageRank - DivRank - SimRank - PathSIM

Module:6	Link Prediction	8 hours

Link Prediction – Applications of Link Prediction – Temporal Changes In a network - Evaluating Link Prediction Methods - Heuristic - Probabilistic - Supervised Random Walk - Information-theoretic Model – Latest trends

Module:7	Community Structure in Networks	6 hours

Applications of Community Detection - Types of Communities - Community Detection Methods - Disjoint Community Detection - Overlapping Community Detection - Local Community Detection - Community Detection vs Community Search - Evaluation of Community Detection Methods

Module:8	Contemporary Topics	2 hours

Guest Lecture from Industry and R & D Organizations

	Total Lecture Hours:	45 Hours

	Total Tutorial Hours		**15 Hours**
Text Book(s)			
1.	Tanmoy Chakraborty, “Social Network Analysis”, 2021, Wiley Publication.		
Reference Books			
1.	Jalal Kawash, “Online Social Media Analysis and Visualization”, 2015, Lecture Notes in Social Networks,		
2	Emmanuel Lazega, Tom A.B Snijders, Nuffield College, “Multilevel Network Analysis for the Social Sciences, Theory, Methods and Applications”, 2016, Springer.		
3	Song Yang, Franziska B Keller, Lu Zheng, “Social Network Analysis: Methods and Examples”, 2016, SAGE Publications, Inc,		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
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