VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF COMPUTER SCIENCE ENGINEERING AND INFORMATION SYSTEMS

Bachelor of Computer Applications

(B.C.A)

Curriculum

(AY 2024-2025 Admitted Students)

INDEX

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 and solve criticalproblems.
- **Impactful People**: Happy, accountable, caring and effective workforce and students.
  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 and compassion.

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

- To be a centre 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.

Bachelor of Computer Applications

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be successful in pursuing higher studies in their chosen field.

2. Graduates will interact with their peers in other disciplines in their work place and society and contribute to the economic growth of the country.

3. Graduates will function in their profession with social awareness and responsibility.

Bachelor of Computer Applications

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

Bachelor of Computer Applications

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B.C.A. (Bachelor of Computer Applications) programme, graduates will be able to

PSO1: To assimilate technical knowledge in diverse areas of computer applications with practical competencies.

PSO2: To acquire technical and professional skills that support career growth and higher educational opportunities.

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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.

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Bachelor of Computer Applications

DETAILED CURRICULUM

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	UBCA101L	Programming in Python	3	0	0	3
	UBCA101P	Programming in Python Lab	0	0	2	1
5	UBCA102L	Computer Organization and Architecture	3	1	0	4
6	UBCA103L	Software Engineering	3	0	0	3
7	UBCA104L	Object Oriented Programming	3	0	0	3
	UBCA104P	Object Oriented Programming Lab	0	0	2	1
8	UBCA105L	Data Structures and Algorithms	3	0	0	3
	UBCA105P	Data Structures and Algorithms Lab	0	0	2	1
9	UBCA106L	Operating Systems	3	0	0	3
	UBCA106P	Operating Systems Lab	0	0	2	1
10	UBCA201L	Computer Networks	3	0	0	3
	UBCA201P	Computer Networks Lab	0	0	2	1
11	UBCA202L	Database Management Systems	3	0	0	3
	UBCA202P	Database Management Systems Lab	0	0	2	1
12	UBCA203L	Programming in Java	3	0	0	3
	UBCA203P	Programming in Java Lab	0	0	2	1
13	UBCA204L	Web Development	3	0	0	3
	UBCA204L	Web Development Lab	0	0	2	1
14	UBCA301L	Full Stack Application Development	3	0	0	3
	UBCA301P	Full Stack Application Development Lab	0	0	2	1
15	UBCA302L	Software Testing	3	0	0	3
	UBCA302P	Software Testing Lab	0	0	2	1
16	UBCA398J	Project	0	0	0	4
					Total Credits	**60**

Bachelor of Computer Applications

Discipline Honours Core Courses

S.No.	Course Code	Course Title	L	T	P	C
1	UBCA401L	Computer Vision	3	1	0	4
2	UBCA402L	Data Analytics	3	0	0	3
	UBCA402P	Data Analytics Lab	0	0	2	1
3	UBCA403L	Soft Computing	3	1	0	4
4	UBCA404L	Machine Learning	3	0	0	3
	UBCA404P	Machine Learning Lab	0	0	2	1
5	UBCA405L	Optimization Techniques	3	1	0	4
Total Credits						**20**

Bachelor of Computer Applications

Discipline Elective Courses

S.No.	Course Code	Course Title	L	T	P	C
1	UCCA115L	Principles of Accounting	3	0	0	3
2	UBCA107L	M-Commerce	3	0	0	3
3	UBCA108L	Enterprise Resource Planning	3	0	0	3
4	UBCA205L	Computer Graphics	3	0	0	3
	UBCA205P	Computer Graphics Lab	0	0	2	1
5	UBCA206L	Data Mining	3	0	0	3
6	UBCA207L	Software Project Management	3	0	0	3
7	UBCA208L	Object Oriented Analysis and Design	3	0	0	3
8	UBCA209L	Data Science	3	0	0	3
9	UBCA303L	Mobile Application Development	3	0	0	3
	UBCA303P	Mobile Application Development Lab	0	0	2	1
10	UBCA304L	Cloud Computing	3	0	0	3
	UBCA304P	Cloud Computing Lab	0	0	2	1
11	UBCA305L	Internet of Things	3	0	0	3
	UBCA305P	Internet of Things Lab	0	0	2	1
12	UBCA306L	Cyber Forensics	3	0	0	3
13	UBCA307L	Big Data Analytics	3	0	0	3
14	UBCA308L	System and Network Administration	3	0	0	3
15	UBCA309L	User Interface Design	3	0	0	3
16	UBCA406L	Blockchain Technology	3	1	0	4
17	UBCA407L	Programming in R	3	0	0	3
	UBCA407P	Programming in R Lab	0	0	2	1
18	UBCA408L	Image Processing	3	0	0	3
	UBCA408P	Image Processing Lab	0	0	2	1
19	UBCA409L	Advanced Java Programming	3	0	0	3
	UBCA409P	Advanced Java Programming Lab	0	0	2	1
20	UBCA410L	Natural Language Processing	3	1	0	4
21	UBCA411L	Artificial Intelligence	3	0	0	3

Bachelor of Computer Applications

Cognitive Systems

S No	Course Code	Course Name	L	T	P	C
1	UCSC215L	Infrastructure Management	3	0	0	3
	UCSC215P	Infrastructure Management Lab	0	0	2	1
2	UBCA304L	Cloud Computing	3	0	0	3
	UBCA304P	Cloud Computing Lab	0	0	2	1
3	UCSC322L	IT Infrastructure	3	1	0	4
4	UCSC323L	Process Management	3	1	0	4
5	UCSC324L	Customer Relationship Management	3	0	0	3
	UCSC324P	Customer Relationship Management Lab	0	0	2	1
6	UCSC325L	Digital Technologies	3	0	0	3
	UCSC352P	Digital Technologies Lab	0	0	2	1
					Total credits	**24**

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	UBCA399J	Summer Internship	2
2	UBCA499J	Research Project/Dissertation	12
		Total credits	14

DISCIPLINE CORE COURSES

Course Code	Course Title	L	T	P	C
UBCA101L	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 control statements and functions in Python
3. To apply the concepts of string and file handling in 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 Programming", 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
UBCA101P	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 control statements and functions in Python
3. To apply the concepts of string and file handling in 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 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
UBCA102L	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 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 the 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: **Total Tutorial hours:**	**45 hours** **15hours**

Text Book(s)	
1	Morris Mano, Rajib Mall, "Computer System Architecture", 2020, Fourth Edition, Pearson.
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, Eleventh edition, Pearson.
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		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
UBCA103L	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 engineering 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 modelling-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		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
UBCA104L	Object Oriented Programming	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To learn the fundamental 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 program 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

Course Code	Course Title	L	T	P	C
UBCA104P	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 C++ 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	5 Hours

	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 C++ program using inheritance and abstract class to compute the salary of employees.	
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

Course Code	Course Title	L	T	P	C
UBCA105L	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**	**6 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**	**7 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 Education.
2	Ellis Horowitz, SartajSahni and Anderson, "Fundamentals of Data Structure in C", 2008, Second edition, University Press.
3	Reema Thareja, "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		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
UBCA105P	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, Second Edition, Oxford Universities 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
UBCA106L	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**	**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", 2020, 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

Course Code	Course Title	L	T	P	C
UBCA106P	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, Ninth Edition, Pearson

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

Course Code	Course Title	L	T	P	C
UBCA201L	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 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 fundamental concepts of network models
2. Analyze the internetworking devices
3. Evaluate the functions 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 protocols 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- Multiple Access Protocols – 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, USA.

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.		
3.	Alberto Leon-Garcia, Communication Networks, 2017, 2nd 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

Course Code	Course Title	L	T	P	C
UBCA201P	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 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 using simulation tools
2. Inspect the performance of error detection and medium access control protocols using simulation tools
3. Analyze the routing algorithms and transport layer protocols using 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

Course Code	Course Title	L	T	P	C
UBCA202L	Database Management Systems	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand the basics of organizing, maintaining and retrieving the information from a Database
2. To examine the fundamental concepts of the relational model, including entity 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 the database design using 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.	Ramez Elmasri 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
UBCA202P	Database Management Systems Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To understand, analyze and design the databases
2. To examine the existing database system, and create new relational database and analyze the design.
3. To implement the database using SQL and PL/SQL Statements

Course Outcomes:

1. Apply SQL interface of a RDBMS package to create, secure, populate and query the database
2. Formulate query and retrieve the information using SQL statements
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, McGraw-Hill Education. Steven Feuerstein, Bill Pribyl, “Oracle PL/SQL Programming”, 2018, Sixth Edition, O'Reilly

2	Media.		
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
UBCA203L	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, multithreaded applications, dynamic and interactive graphical applications using JavaFX
3. To apply the concept of file handling 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-Menus-Different types of Layouts-Event handling –Java Stream 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
UBCA203P	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

Course Code	Course Title	L	T	P	C
UBCA204L	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 Media.
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”, 5th edition, Addison-Wesley Professional.

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
UBCA204P	Web Development Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

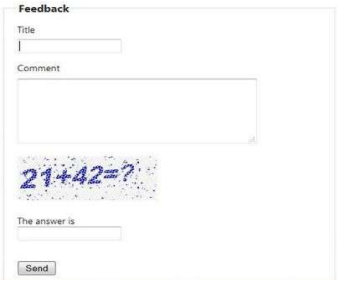
1. To understand, analyze and design websites and online applications
2. To explore and use key programming concepts to build a dynamic website using PHP

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 Use cookies for storing the user details and display the username when the user moves on to the next page	4 Hours
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.	2 Hours

	vi) Calculate the total salary per year for each employee and display it.	
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

Course Code	Course Title	L	T	P	C
UBCA301L	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 develop a 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	NodeJS	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
UBCA301P	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 Professional.		
Mode of Evaluation: 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
UBCA302L	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
3. To create and automate 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 various test processes for improving the quality of software
4. Plan and manage the various test process
5. Validate 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

Course Code	Course Title	L	T	P	C
UBCA302P	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, Manning Publication.
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

CAPSTONE PROJECT

Course Code	Course Title	L	T	P	C
UBCA398J	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

DISCIPLINE HONORS COURSES

Course Code	Course Title	L	T	P	C
UBCA401L	Computer Vision	3	1	0	4
Pre-requisite		**Syllabus version**			
		v.1.0			

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 Outcomes:

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:	**45 hours**
	Total Tutorial 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

Mode of Evaluation: CAT, Written Assignment, tutorials, 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
UBCA402L	Data Analytics	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To impart the importance of analytics on stored data
2. To learn and explore the data through visualization
3. To analyze data using various tools

Course Outcomes:

1. Apply the concepts of DBMS and create organized data for analysis.
2. Explore the data and generate layman understandable data associations through visualization methods.
3. Analyze the data using required formulas and functions
4. Use appropriate tools for analysis

Module:1	**Data Organization**	**5 hours**
Introduction - Structure - OLTP Databases, merits and demerits - need for Data warehouse and data analytics - Different types of analytics		
Module:2	**Business Intelligence**	**5 hours**
BI Characteristics - Data Quality, Structured vs Unstructured - Data lake, Data Warehouse, Benefits and Use cases of Modern BI,		
Module:3	**Data Visualization types**	**6 hours**
Aims and Importance of Data Visualization - Different types-Chart, Tables, Graphs, Maps, Dash board and Info graphics		
Module:4	**Reporting tools**	**7 hours**
Introduction to Pentaho – Tableau – Tibco Jaspersoft – Domo - Sisense, High Charts and best practices		
Module:5	**Transforming Data**	**7 hours**
Combining data -Joiner -aggregating values – concatenate – math formula – Group Loop start – Loop end – string to date and time – table row to variable – Line plot		
Module:6	**Power BI**	**6 hours**
Power BI in a nutshell – Loading data – Transforming Data – Defining the Data model -Building visuals		
Module:7	**Importing data**	**7 hours**
Import files-CSV, Text, Data from Web, Data from Master table, Dash board – Interactive Dash board.		
Module:8	Contemporary Issues	**2 hours**
Guest lecture from industry and R & D organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Dr. Gaurav Aroraa, Chitra lele and Dr. Munish Jindal, “Data Analytics : Principles, Tools & Practices”, 2022, First edition, BPB Publication
2. Andrea De Mauro, “Data Analytics Made Easy”, 2021, First edition, Packt Publishing

Reference Books

1. Ramesh Sharda, Dursun Delen, Efraim Turban, “Business Intelligence, Analytics, and Data Science: A Managerial Perspective”, 2017, Fourth edition, Pearson.

2.	Ken Puls & Miguel Escobar," Master Your Data -Power Query in Excel and Power BI", 2021,Holy Macro Books		
Mode of Evaluation: CAT, Written Assignment, tutorials, 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
UBCA402P	Data Analytics Lab	0	0	2	1
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To explore the data through visualization
2. To analyze data using various tools

Course Outcomes:

1. Create objects to explore the data through visualization
2. Use appropriate tools for analysis

Indicative Experiments		Hours
1.	Transforming Data – Modeling Data, Combining Tables, Aggregate Functions	4 hours
2.	Transforming Data – Date, Statistical, Lookup and Reference Functions	6 hours
3.	Power BI- Loading, Transforming, Defining the Data modeling.	4 hours
4.	Power BI- Operations on Pivot Table and Power Query.	4 hours
5.	Importing Data from Files and Web.	2 hours
6.	Visualization – Creating Charts, Graphs ,etc..,	5 hours
7.	Visualization – Dash Board and Info Graphics.	5 hours
	Total Laboratory Hours	30 hours

Text Books

1. Analyzing Data with Power BI and Power Pivot by uCertify Labs , 2023 Pearson IT Certification.
2. Ken Puls & Miguel Escobar," Master Your Data -Power Query in Excel and Power BI", 2021,Holy Macro Books

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
UBCA403L	Soft Computing	3	1	0	4
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 - Case Study: Multi-input combinational logic gate simulations

Module:2	Supervised Neural Networks	6 Hours

Supervised Neural Networks – Perceptron - MLP- Adaline (Adaptive Linear Neuron)- Back-Propagation Network - Radial Basis Function Network - Case Study: Simple linear regression applications

Module:3	Associative Memory Networks	6 Hours

Pattern Association - Memory Models -Auto-Associative and Hetero Associative Models - Bi Directional Associative Memory Model - Case Study: Decision making using associative memory

Module:4	Unsupervised Neural Networks	6 Hours

Kohonen Self-Organizing Feature Maps, Learning Vector Quantization Network, Adaptive Resonance Theory Network - Case Study: Clustering in wireless Networks

Module:5	Fuzzy Sets and Fuzzy Relations	6 Hours

Introduction - Fuzzy Sets – Operations - Fuzzy Relations - Membership Functions -Fuzzification and Defuzzification - Case Study: Fuzzy controllers in control system applications

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 - Case Study: Matlab implementation of FIS

Module:7	Genetic Algorithm	6 Hours

Basic Concepts of Genetic Modeling - Encoding, Selection, Crossover, Mutation, Reproduction, Applications in Search and Optimization - Case Study: Resource allocation using GA

Module:8	Contemporary Topics Expert lecture	2 hours

Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours: **Total Tutorial hours:**	**45 hours** **15 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	
Mode of Evaluation: CAT, Written Assignment, tutorials, 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
UBCA404L	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, 2nd Edition,O'Reilly Media, Inc.
2. Ethem Alpaydin, "Introduction to Machine Learning", 2020, Fourth Edition, MIT Press.

Reference Books

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective ",2014, Second Edition", CRC 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

Course Code	Course Title	L	T	P	C
UBCA404P	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, 2nd 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
UBCA405L	**Optimization Techniques**	3	1	0	4
Pre-requisite				**Syllabus version**	
				v.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**
Expert talk from industry or research institution		

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

DISCIPLINE ELECTIVE COURSES

Course Code	Course Title	L	T	P	C
UBCA107L	M-Commerce	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To understand the employment and Self - employment opportunities in the fields of E-Commerce and M-Commerce
2. To function adequate knowledge and understanding about M-Commerce Practices to the students
3. To examine the exposure of the students towards environment and Operations in the field of M – Commerce

Course Outcomes:

1. Understand the concept of e-Commerce environment, technology and infrastructure in reinforcements of the business.
2. Identify the opportunities and challenges offered by M-Commerce and to incubate new Businesses.
3. Examine the ethical issues related to Mobile communication.
4. Develop a mobile network over TCP/IP and WAP architecture.
5. Analyze the various payment and security systems in M-commerce and help in business growth and Mobile information services.

Module:1	Introduction to Mobile Commerce	6 hours
Overview of an E-Commerce environment - Introduction to mobile commerce-scope, benefits, limitations, framework; Mobile commerce services-Location Based Services, information services-Relevance of M-commerce in Modern society - M-commerce applications		
Module:2	**Mobile Commerce Technology**	**6 hours**
Wireless and mobile communications - Digital cellular technology - mobile access technology - Evolution of mobile communication systems - 4G and 5G Systems – Applications		
Module:3	**Mobile Commerce Key Players**	**6 hours**
Mobile devices - mobile service providers - mobile network operators - mobile virtual network operators - types of MVNO - List of MVNO - mobile commerce service providers		
Module:4	**Mobile Products**	**7 hours**
Mobile banking - mobile banking business models - mobile banking technologies - services - advantages and challenges of mobile banking - mobile ticketing - mobile tickets providers - Mobile payments – characteristics - payment models - types of mobile payments - mobile payment service providers - mobile computing		
Module:5	**Security and Legal aspects**	**6 hours**
Mobile security concepts - security mechanism: Encryption, digital signatures, digital certificates, Public key infrastructure, firewalls, proxy servers - Network Security - Legal aspects: Mobile device related laws		
Module:6	**Future of Mobile commerce**	**6 hours**
Mobile commerce and consumer acceptance - growth of mobile value added services - mobile fraud detection - future trends		
Module:7	**M-commerce case studies**	**6 hours**
Mobile shopping - Mobile Business intelligence - Mobile CRM - Mobile education		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		

	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Karabi Bandyopadhyy, ”Mobile commerce” ,2021,second edition, Eastern Economy Edition, PHI Learning Pvt.Ltd	
Reference Books		
1	Punita Duhan and Anurag singh , “M-commerce –Experiencing the Phygital Retail” , 2019,Third edition ,Apple Academic 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

Course Code	Course Title	L	T	P	C
UBCA108L	Enterprise Resource Planning	3	0	0	3
Prerequisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To Understand recent ERP concepts and Methodologies.
2. To Emphasize the modern business processes and systems.
3. To Automate business solutions using ERP tools

Course Outcomes:

1. Understand the integrated information systems and business intelligence systems.
2. Develop the architecture of an ERP Systems.
3. Apply the internal and external information flows among the corporate functions
4. Analyze the critical issues of an ERP Systems
5. Evaluate ERP problems using an open source ERP packages

Module:1	**Basic ERP Concepts**	**4 hours**
Introduction - Common ERP Myths - History of ERP - Roadmap for Successful ERP Implementation - ERP Architectures - Risks and Benefits of ERP		
Module:2	**Business Modules of an ERP Package**	**7 hours**
Business Modules - Financial Module - Production Module - Plant Maintenance Module - Human Resources Management module - Material Management Module - Quality Management Module – Marketing Module - Sales, Distribution and Service Module - Integration of ERP, Supply chain and Customer Relationship Applications		
Module:3	**ERP Implementation Life Cycle**	**7 hours**
Different Phases of Implementation - ERP Package Selection - Transition Strategies - Bing Bang Strategy – Phased Implementation – Parallel Implementation - Process line Transition Strategy – Hybrid Transition Strategy		
Module:4	**ERP Deployment Models**	**7 hours**
On-Premises ERP Systems - Cloud/hosted ERP Systems - Implementation Methodologies - ERP Project Teams - Consultants, Vendors and Employees		
Module:5	**ERP Operation and Maintenance**	**6 hours**
Post Implementation Issues - Ongoing Implementation Efforts - Upgrading versus New Software - ERP Maintenance Phase - Maximizing the ERP System		
Module:6	**ERP and E-Business**	**6 hours**
Supply Chain Integration: Components, E-business Process Model and Integration - ERP, Internet and WWW - Best practices of ERP II		
Module:7	**Future Directions and Trends in ERP**	**6 hours**
Faster Implementation Methodologies - Easier Customization Tools - Industry Specific solutions - Open Source ERP – Case Studies		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)			
1.	Alexis Leon, “Enterprise Resource Planning”, 2019, Fourth Edition, McGraw Hill.		
Reference Books			
1	Rajesh Ray, “Enterprise Resource Planning: Text and Cases”,2017, First Edition, McGraw Hill.		
2.	Steven Scott Phillips, “Control Your ERP Destiny: Reduce Project Costs, Mitigate Risks and Design Better Business Solutions”, 2022, Second Edition, Street Smart ERP 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
UBCA205L	Computer Graphics	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To Explore a comprehensive introduction to computer graphics.
2. To provide an understanding of mapping from a world coordinate to device coordinates, clipping, and projections.
3. To offer exposure to the various computer graphics applications/tools/technologies.

Course Outcomes:

1. Demonstrate the knowledge of the fundamental concepts of computer graphics techniques.
2. Design and problem-solving skills with application to computer graphics.
3. Understand core architectural concepts of the typical graphics pipeline.
4. Implement various algorithms to scan, convert the basic geometrical primitives, transformations, area filling and clipping techniques.
5. Provide the knowledge of display systems and interactive control of 3D computer graphics applications.

Module:1	Introduction to Computer Graphics	5 hours

Introductions: Broad classifications of computer graphics-Architecture of interactive computer graphics-Applications of computer graphics; Display devices: Display systems-CRT display devices- Flat panel display devices-projectors- Hard copy devices.

Module:2	Graphics Output Primitives	7 hours

Line Drawing Algorithms: DDA Algorithm- Bresenham's Line Algorithm- Midpoint Line Algorithm. Circle Generating algorithms: Properties of Circles- Bresenham's Circle Algorithm-Midpoint Circle Algorithm-Fill Area Primitives: Polygon Fill Area- Polygon Classifications.

Module:3	Attributes of Graphics Primitives	5 hours

Classification of attributes of output primitives: Point Attributes-Line Attributes-Curve Attributes-Fill Area Attributes- Color attributes-Character Attributes-Antialiasing techniques.

Module:4	2D Transformations, 2D Viewing Transformation, and Clipping	8 hours

Two-Dimensional Transformation: Introduction-Classifications of Transformations- Types of transformations-Representations of point and object-Coordinate Transformation-Homogeneous coordinate. 2D viewing: Introduction- Window- Viewport- Viewing Transformation-Normalization Transformation-Workstation Transformation. Clipping: Clipping algorithms.

Module:5	3D Transformations and 3D Viewing	7 hours

3D Transformations: Introduction-3D Geometry-3D Transformation-3D Coordinate Transformations-Relationship between Geometric and Coordinate Transformation matrices. 3D Viewing and Clipping - Projection: Introduction- Classification of 3D to 2D projections-Basic Definitions of the subclasses of parallel projection and perspective projections-Projections based up on Locations of centre of projection and view plane.

Module:6	Color Models	5 hours

Introduction- Two basic color approaches-Color Models.

Module:7	Hidden Lines and Hidden Surfaces	6 hours

Hidden Lines and Hidden Surfaces: Introduction–Z-Buffer Algorithm (Depth-Buffer Algorithm) – A Buffer method- The Painters Algorithm (Depth-Sort Algorithm)-Area-subdivision Algorithm- Scan Line Algorithm.

Module:8	Contemporary issues:	2 hours

Guest Lecture from Industry and R & D Organizations			
	Total Lecture hours:		**45 hours**
Textbook(s)			
1. Pradeep. K. Bhatia, "Computer Graphics",2019, Third Edition, Wiley, New Delhi.			
Reference Books			
1. Dr Rajiv Chopra, "Computer Graphics", 2015, Fourth Edition, S Chand and Company Pvt. Ltd, New Delhi. 2. Hearn, Donald D., and Baker, M. Pauline, "Computer Graphics using OpenGL", 2013, Fourth Edition, Prentice-Hall Professional Technical Reference.			
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
UBCA205P	Computer Graphics Lab	0	0	2	1
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To understand, analyze and design graphics objects.
2. To practice on graphics packages both 2D and 3D concepts

Course Outcomes:

1. Create graphics objects with the help of computer programming languages.
2. Design of 2D and 3D objects and curves.
3. Implementation of scan conversion, filling, and clipping.

	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 output primitives: Create and implement graphics objects using Line drawing algorithms - Create and implement graphics objects using Circle generating algorithm.	4 Hours
3.	Area Filling: Create and implement graphics objects apply fillings with help of area filling algorithms.	4 Hours
4.	2D Transformations: Create and implement graphics objects using the 2D transformations methods like translation, scaling, rotation, reflection, and shearing.	4 Hours
5.	2D Viewing: Create and implement of Line clipping algorithms against the given rectangular window	4 Hours
6.	3D Transformations: Create and implement graphics objects using the 3D transformations methods like translation, scaling, rotation, and reflection	4 Hours
7.	3D Viewing (Projection methods): Create and implement graphics objects to demonstrate the use of the 3D viewing transformations and projections	4 Hours
8.	Curves Create and implement of quadratic curves like Bezier and spline	4 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1. Pradeep. K. Bhatia, “Computer Graphics”, 2019,Third Edition, Wiley, New Delhi.
2. Paperback, Jan Donald Hearn, Pauline Baker, "Computer Graphics with OPENGL - C Version", 2011,Fourth Edition, Pearson 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
UBCA206L	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
UBCA207L	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 learn the monitoring function 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
UBCA208L	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**	**6 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**	**3 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
UBCA209L	Data Science	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To provide fundamental knowledge on data science with querying and analytics required for the field of data science.
2. To understand the process of handling heterogeneous data, pre-process and visualize them for better understanding.
3. To gain the fundamental knowledge on data science tools and gain basic skill set to solve real-time data science problems.

Course Outcomes:

1. Ability to obtain fundamental knowledge on data science.
2. Demonstrate proficiency in data science Technologies.
3. Apply advanced tools to work on dimensionality reduction and mathematical operations.
4. Understand various types of data and visualize them through programming for knowledge representation.
5. Apply numerous open source data science tools to solve real-world problems through industrial case studies.

Module:1	Introduction	4 hours

Data Science: Benefits and uses – Data scientist - Difference between Data science and business intelligence - Data Science lifecycle - Pros and cons of Data Science – Statistics for Data Science

Module:2	Data Science Methodology	8 hours

Analytics for Data Science – Examples of Data Analytics – Data Analytics Lifecycle: Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results.

Module:3	Statistics for Data science	8 hours

Data Types - Variable Types – Statistics - Sampling Techniques and Probability - Information Gain and Entropy - Probability Theory - Probability Types - Probability Distribution - Bayes Theorem - Inferential Statistics.

Module:4	Databases for Data Science	7 hours

Structured Query Language (SQL): Basic Statistics, Data Munging, Filtering, Joins, Aggregation, Window Functions, Ordered Data, No-SQL: Document Databases, Wide-column Databases and Graphical Databases

Module:5	Data Visualization	6 hours

Data visualization, Visualization workflow- describing data visualization workflow, Analysis-Four Levels for Validation Data Representation- chart types- categorical, hierarchical, relational, temporal & spatial.

Module:6	Platform for Data Science	6 hours

Python integrated Development Environments (IDE) for Data Science – Python Libraries – Data Frame Manipulation with numpy and pandas – Exploration Data Analysis – Time Series Dataset –Clustering, Dimensionality Reduction.

Module:7	Application of Data Science	4 hours

Risk and Fraud Detection – Healthcare - Genetics and Genomics - Drug Development - Internet Search - Website Recommendations - Advanced Image Recognition - Virtual Assistance - Speech Recognition - Planning Routes for Airplanes – Gaming - Augmented Reality

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R & D Organizations

Total Lecture hours:			**45 hours**
Text Book(s)			
1.	Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, 'Fundamentals of Data Science,2022, First Edition, CRC Press.		
Reference Books			
1.	AniAdhikari and John DeNero, "Computational and Inferential Thinking: The Foundations of Data Science", 2019, GitBook.		
2.	Jake VanderPlas, "Python Data Science Handbook", 2016, O'Reilly.		
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
UBCA303L	Mobile Application Development	3	0	0	3
Pre-requisite		**Syllabus version**			
		v. 1.0			

Course Objectives:

1. To impart fundamental concepts of Mobile Application 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. Analyze performance of mobile applications and understand the role of permissions and security.

Module:1	**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:2	**Activities, Fragments and Intents**	**7 hours**
Understanding Activities – Linking Activities using Intents – Displaying a Dialog Window – Fragments- Adding Fragments Dynamically, Life Cycle of a Fragment		
Module:3	**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:4	**Designing User Interface with Views**	**7 hours**
Basic Views – Picker Views – List Views to display Long Lists – Understanding Specialized Fragments - List Fragment, Dialog Fragment, Preference Fragment - Menus with Views- Options Menu, Context Menu		
Module:5	**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:6	**Messaging and Location-Based Services**	**6 hours**
SMS Messaging – Sending Email – Displaying Maps – Getting Location Data – Monitoring a Location		
Module:7	**Networking and Android Services**	**5 hours**
Consuming Web Services using HTTP – Consuming JSON Services - Creating Own Services – Establishing Communication Between a Service and an Activity – Binding Activities to Service		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book

1. J F DiMarzio, “Beginning Android Programming with Android Studio”, 2017, Fourth Edition, Wiley

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" , 2017, Eighth edition, 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
UBCA303P	Mobile Application 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 – moving to another activity, passing data between Activities	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. 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” , 2017, Eighth edition, Payload Media Inc.

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
UBCA304L	Cloud Computing	3	0	0	3
Prerequisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To learn recent cloud computing paradigms and cloud infrastructures.
2. To emphasize the understanding of virtualization in the cloud environment.
3. To appreciate concepts of programming paradigms, security, and storage in the cloud environment.

Course Outcomes:

1. Understand cloud computing and virtualization concepts in clouds.
2. Develop applications in cloud environments.
3. Understand the concepts of Serverless Applications and Cloud Storage.
4. Analyze appropriate programming approaches and tools to set up clouds.
5. Explore possible ways for providing secured cloud services.

Module:1	**Introduction**	**4 hours**
Characteristics - Cloud Models - Cloud Computing Concepts and Technologies - Cloud Computing Services and Platform - Case Studies		
Module:2	**Virtual Machines and Compute Services**	**6 hours**
Virtualization - Elastic Compute Cloud - Auto Scaling - Elastic Load Balancing- Virtual Private Cloud		
Module:3	**Cloud Application Development**	**6 hours**
Design Considerations - Design Methodologies - Reference Architectures for Cloud Applications - Introduction to Python Framework - RESTful Web API- Case Studies		
Module:4	**Serverless Applications**	**7 hours**
Introduction to Serverless Computing - Serverless Use Cases- Serverless Design Patterns - Lambda- Serverless Concepts - Case Studies		
Module:5	**Cloud Storage**	**7 hours**
Simple Storage Service (S3) - Elastic File System (EFS) - Elastic Block Store (EBS)- Storage Gateway - Relational databases - NoSQL databases		
Module:6	**Batch Analytics and Real-time Analytics**	**6 hours**
HDFS - Hadoop - MapReduce - Pig - Storm - Spark - Flink - Case Studies		
Module:7	**Cloud Security**	**7 hours**
Cloud Security Architecture - Authentication - Authorization - Identity and Access Management - Data security - Key management - Auditing - CloudHSM - Directory Service		
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”, 2019, First Edition, VPT Publisher

Reference Books			
1	Douglas E. Comer, "The Cloud Computing Book: The Future of Computing Explained", 2021, First Edition, CRC Press		
2.	Ian Foster and Dennis B. Gannon, "Cloud Computing for Science and Engineering", 2017, First Edition, The MIT Press, Cambridge, Massachusetts		
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
UBCA304P	Cloud Computing 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 VMs to deploy simple applications.	3 hours
3	Deploy SaaS/PaaS/IaaS applications.	4 hours
4	Develop cloud application with python web application framework.	4 hours
5	Develop applications using MapReduce programming model.	4 hours
6	Design RESTfull web APIs for simple applications.	4 hours
7	Setup RDS database instances.	4 hours
8	Develop real-world applications in cloud environments.	4 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1	Arshdeep Bahga & Vijay Madisetti, "Cloud Computing Solutions Architect: A Hands-On Approach", 2019, FirstEdition, VPT Publisher.
2	Douglas E. Comer, "The Cloud Computing Book: The Future of Computing Explained", 2021, First Edition, CRC Press, Florida.

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
UBCA305L	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, USA, 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
UBCA305P	**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, 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
UBCA306L	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 be 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 evidence 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 Electronic Communication Device - Information and Communication Technology -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	**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

Course Code	Course Title	L	T	P	C
UBCA307L	Big Data Analytics	3	0	0	3
Pre-Requisite		**Syllabus version**			
		v.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 perform real time and batch processing using appropriate tools and techniques.

Course Outcomes:

1. Identify big data systems and design for analysis.
2. Analyze data stored in Hadoop.
3. Apply MapReduce based analysis
4. Implement Hadoop tools for unstructured data analytics
5. Process Data using Spark and No SQL Databases.

Module:1	**Introduction to Big Data Concepts**	**5 hours**
Evolution of Big data – Structure of Big data, Elements of Big data, Different Types of Analytics – Characteristics - Analytics Cycle - Big Data Challenges and Applications in Industries		
Module:2	**Understanding Hadoop Eco system**	**5 hours**
Introduction to Hadoop, Terminologies; Hadoop Distributed File System - Design, Read and Write in HDFS, Commands; Cluster Architecture- Eco System and Tools		
Module:3	**MapReduce Framework**	**6 hours**
MapReduce - Different Phases, Shuffle & Sort, Reducer and combiner; Classic - Components - Job Tracker & Task Tracker, Yarn – Components, Techniques to optimize MapReduce jobs- Use of MapReduce		
Module:4	**Hadoop Database**	**6 hours**
Hbase – data model and implementations, Hbase clients, Hbase examples, Hive – data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.		
Module:5	**Understanding Hadoop YARN**	**7 hours**
YARN Architecture –Resource Manager, Application Manager, Schedulers, YARN Configurations, Commands, Compatibility with YARN, Advantages of YARN		
Module:6	**Hadoop Related tools**	**8 hours**
Introduction of Pig , Pig data model, Pig Latin ,Pig operations, developing and testing Pig Latin scripts; Sqoop		
Module:7	**No SQL Data Management**	**6 hours**
Introduction to NoSQL – aggregate data models, key-value and document data models, relationships , graph databases, schema less databases, materialized views ,distribution models, master-slave replication, consistency; Cassandra – Cassandra data , Cassandra examples		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)			
1.	DT Editorial Services, “Big Data 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.	Tom White, “Hadoop – The Definitive Guide: Storage and Analysis at Internet Scale”, 2015, O′Reilly		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council		Date	

Course Code	Course Title	L	T	P	C
UBCA308L	System and Network Administration	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To understand the fundamental principles of system and network administration.
2. To make the students design and implement enterprise-level networks with its services.
3. To develop familiarity with the components that comprise systems and networks.

Course Outcomes:

1. Design and implement a network architecture that meets the needs of an organization.
2. Diagnose and troubleshoot common issues that arise in system and network administration.
3. Suggest a backup and recovery plan for critical systems and data.
4. Identify and implement security measures to protect systems and data from threats.
5. Analyze and select emerging technologies for system and network administration based on their suitability for a particular context

Module:1	Introduction to System and Network Administration	6 hours

Introduction to system administration and network administration – Game-changing strategies - Climbing Out of the Hole, The Small Batches Principle, Pets and Cattle, and Infrastructure as Code

Module:2	Workstation Fleet Management	8 hours

Workstation Architecture - Workstation Hardware Strategies - Workstation Software Life Cycle - OS Installation Strategies - Workstation Service Definition - Workstation Fleet Logistics - Workstation Standardization

Module:3	Servers	6 hours

Servers - Server Hardware Strategies - Server Hardware Features - Server Hardware Specifications

Module:4	Services	6 hours

Services - Service Planning and Engineering - Service Resiliency and Performance Patterns - Service Launch: Fundamentals - Service Conversions - Disaster Recovery and Data Integrity

Module:5	Infrastructure	6 hours

Network Architecture - Network Operations - Datacenters Overview - Running a Datacenter

Module:6	Change Processes	6 hours

Change Management - Server Upgrades - Maintenance Windows - Centralization Overview - Centralization Recommendations - Centralizing a Service

Module:7	Service Recommendations	5 hours

Service Monitoring - Email Service - Data Storage - Backup and Restore - Web Services

Module:8	Contemporary Topics	2 hours

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	45 hours

Text Book(s)

1. Thomas A. Limoncelli, Strata R. Chalup, Christina J. Hogan, "The Practice of System and Network Administration: Volume 1: DevOps and other Best Practices for Enterprise IT", 2016, Third Edition, Addison-Wesley Professional

Reference Books

1. Jennifer Davis, "Modern System Administration", 2022, O'Reilly Media
2. Naim Kapucu, Qian Hu, "Network Governance Concepts, Theories, and Applications", 2020, First Edition, Routledge, Taylor and Francis Group.

Course Code	Course Title	L	T	P	C
UBCA308L	System and Network Administration	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To understand the fundamental principles of system and network administration.
2. To make the students design and implement enterprise-level networks with its services.
3. To develop familiarity with the components that comprise systems and networks.

Course Outcomes:

1. Design and implement a network architecture that meets the needs of an organization.
2. Diagnose and troubleshoot common issues that arise in system and network administration.
3. Suggest a backup and recovery plan for critical systems and data.
4. Identify and implement security measures to protect systems and data from threats.
5. Analyze and select emerging technologies for system and network administration based on their suitability for a particular context

Module:1	Introduction to System and Network Administration	6 hours

Introduction to system administration and network administration – Game-changing strategies - Climbing Out of the Hole, The Small Batches Principle, Pets and Cattle, and Infrastructure as Code

Module:2	Workstation Fleet Management	8 hours

Workstation Architecture - Workstation Hardware Strategies - Workstation Software Life Cycle - OS Installation Strategies - Workstation Service Definition - Workstation Fleet Logistics - Workstation Standardization

Module:3	Servers	6 hours

Servers - Server Hardware Strategies - Server Hardware Features - Server Hardware Specifications

Module:4	Services	6 hours

Services - Service Planning and Engineering - Service Resiliency and Performance Patterns - Service Launch: Fundamentals - Service Conversions - Disaster Recovery and Data Integrity

Module:5	Infrastructure	6 hours

Network Architecture - Network Operations - Datacenters Overview - Running a Datacenter

Module:6	Change Processes	6 hours

Change Management - Server Upgrades - Maintenance Windows - Centralization Overview - Centralization Recommendations - Centralizing a Service

Module:7	Service Recommendations	5 hours

Service Monitoring - Email Service - Data Storage - Backup and Restore - Web Services

Module:8	Contemporary Topics	2 hours

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	45 hours

Text Book(s)

1. Thomas A. Limoncelli, Strata R. Chalup, Christina J. Hogan, "The Practice of System and Network Administration: Volume 1: DevOps and other Best Practices for Enterprise IT", 2016, Third Edition, Addison-Wesley Professional

Reference Books

1. Jennifer Davis, "Modern System Administration", 2022, O'Reilly Media

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

Course Code	Course Title	L	T	P	C
UBCA308L	System and Network Administration	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

Course Objectives:

1. To understand the fundamental principles of system and network administration.
2. To make the students design and implement enterprise-level networks with its services.
3. To develop familiarity with the components that comprise systems and networks.

Course Outcomes:

1. Design and implement a network architecture that meets the needs of an organization.
2. Diagnose and troubleshoot common issues that arise in system and network administration.
3. Suggest a backup and recovery plan for critical systems and data.
4. Identify and implement security measures to protect systems and data from threats.
5. Analyze and select emerging technologies for system and network administration based on their suitability for a particular context

Module:1	Introduction to System and Network Administration	6 hours

Introduction to system administration and network administration – Game-changing strategies - Climbing Out of the Hole, The Small Batches Principle, Pets and Cattle, and Infrastructure as Code

Module:2	Workstation Fleet Management	8 hours

Workstation Architecture - Workstation Hardware Strategies - Workstation Software Life Cycle - OS Installation Strategies - Workstation Service Definition - Workstation Fleet Logistics - Workstation Standardization

Module:3	Servers	6 hours

Servers - Server Hardware Strategies - Server Hardware Features - Server Hardware Specifications

Module:4	Services	6 hours

Services - Service Planning and Engineering - Service Resiliency and Performance Patterns - Service Launch: Fundamentals - Service Conversions - Disaster Recovery and Data Integrity

Module:5	Infrastructure	6 hours

Network Architecture - Network Operations - Datacenters Overview - Running a Datacenter

Module:6	Change Processes	6 hours

Change Management - Server Upgrades - Maintenance Windows - Centralization Overview - Centralization Recommendations - Centralizing a Service

Module:7	Service Recommendations	5 hours

Service Monitoring - Email Service - Data Storage - Backup and Restore - Web Services

Module:8	Contemporary Topics	2 hours

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	45 hours

Text Book(s)

1. Thomas A. Limoncelli, Strata R. Chalup, Christina J. Hogan, "The Practice of System and Network Administration: Volume 1: DevOps and other Best Practices for Enterprise IT", 2016, Third Edition, Addison-Wesley Professional

Reference Books

1. Jennifer Davis, "Modern System Administration", 2022, O'Reilly Media

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
UBCA309L	User Interface Design	3	0	0	3
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To understanding the concepts that are necessary to produce effective interface designs
2. To extend knowledge about development methodologies, evaluation techniques, task analysis, and prototyping
3. To analyze various types of interfaces to create new interface design.

Course Outcomes:

1. Understand human computer interaction theories and principles.
2. Demonstrate the prototyping techniques and guidelines for the conceptual and physical design
3. Evaluate human-computer interaction principles and the discovery process.
4. Create a user interface with appropriate professional tools.
5. Design predictive models and real world applications.

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; Interface metaphors, Paradigms of interaction		
Module:2	**Cognition and Design**	**8 hours**
Conceptual frameworks for cognition: Mental models, Information processing, External Cognition; Social mechanisms used in communication and collaboration: Conversational mechanisms, Coordination mechanisms, Awareness mechanisms		
Module:3	**Emotional Interaction and Interfaces**	**6 hours**
Expressive Interfaces and Emotional Design - Annoying Interfaces -Affective Computing and Emotional AI - Persuasive Technologies and Behavioral Change -Anthropomorphism-Interface Types		
Module:4	**Needs and Requirements**	**6hours**
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**
Introduction – Prototyping - Conceptual Design- Concrete Design- Generating Prototypes-Construction-AgileUX-Design Patterns- Open Source Resources-Tools		
Module:6	**Evaluation and Framework**	**7 hours**
Introduction -Types of Evaluation- Evaluation Case Studies -Other Issues		
Module:7	**Design and Evaluation in Real-world**	**6 hours**
Usability Testing - Conducting Experiments - Field Studies - Inspections: Heuristic Evaluation and Walk-Throughs -Analytics and A/B Testing-Predictive Models		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 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
UBCA406L	Blockchain Technology	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: **Total Tutorial Hours:**	**45 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",2018, 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

Course Code	Course Title	L	T	P	C
UBCA407L	Programming in R	3	0	0	3
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives

1. To understand the fundamental concepts of R programming
2. To comprehend the various functions and properties of R programming
3. To Understand the data graphics and statistical techniques using R programming

Course Outcomes:

1. Understand the basics of R programming in terms of data types and variables
2. Use the data frames, functions and control statements for accessing data
3. Visualize and summarize the data using R programming
4. Understand the data using string and regular expressions techniques
5. Apply various programming structures in solving statistical problems

Module:1	**Basics of R**	**5 hours**

Getting R, The R Environment, R Packages - Installing Packages - Loading Packages - Building a Package, Basics of R - Basic Math - Variables - Data Types - Vectors - Calling Functions - Function Documentation - Missing Data – Pipes

Module:2	**Advanced Data Types and Files**	**6 hours**

Data Frames - Lists - Matrices – Arrays, Reading Data into R - Reading CSVs - Excel Data - Reading from Databases - Data from Other Statistical Tools - R Binary Files - Data Included with R - Extract Data from Web Sites - Reading JSON Data

Module:3	**Functions and Control Statements**	**6 hours**

Writing R functions - Function Arguments, Return Values, do.Call - Control Statements - if and else - switch – if else - Compound Tests - Loops, the Un-R Way to Iterate - for Loops - while Loops - Controlling Loops

Module:4	**Data visualization, Transformation and Tidying**	**7 hours**

Data visualization - ggplot2 calls - Visualizing distributions - Visualizing relationships - Saving plots, Data transformation - Rows - Columns -The pipe -Groups, Data Tidying -Tidy data -Lengthening data -Widening data

Module:5	**Strings and Regular Expressions**	**6 hours**

Strings - Creating a string -Creating many strings from data - Extracting data from strings - Letters - Non - English text, Regular Expressions - Pattern basics - Key functions - Pattern details - Pattern control -Regular expressions in other places

Module:6	**Probabilistic Techniques**	**6 hours**

Probability Distributions - Normal Distribution - Binomial Distribution - Poisson Distribution- Other Distributions

Module:7	**Statistical Techniques**	**7 hours**

Basic Statistics - Summary Statistics - Correlation and Covariance - T-Tests: One-Sample T-Test, Two-Sample T-Test, Paired Two-Sample T-Test – ANOVA

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

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	**45 hours**

Text Book(s)

1. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, 2017, Second Edition, Addison-Wesley Professional

2.	Hadley Wickham, Mine Çetinkaya-Rundel, Garrett Grolemund, R for Data Science, Second Edition, 2023, O'Reilly Media		
Reference Books			
1.	Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, 2011, No Starch 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

Course Code	Course Title	L	T	P	C
UBCA407P	Programming in R Lab	0	0	2	1
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

1. To manipulate data within R and to create simple graphs and charts used in introductory statistics
2. To Perform and interpret different distributions using R
3. To Carry out hypothesis testing and calculate confidence intervals; Perform linear regression models for data analysis

Course Outcomes:

1. Understand and use R – Data types and Data Structures.
2. Develop programming logic using R – Packages.
3. Analyze data sets using R – programming capabilities.

Indicative Experiments		Hours
1.	Describing Data using R ● Viewing and Manipulating Data ● Plotting Data ● Reading in Your Own Data	3 Hours
2.	Visualizing Data ● Tables, charts and plots. Visualizing Measures of Central Tendency, Variation, and Shape. Box plots, Pareto diagrams	3 Hours
3.	Visualizing Two variables ● Scatterplot, Box plot, Bar chart, Line chart	3 Hours
4.	Probability Distributions ● Generate and Visualize Discrete and continuous distributions using the statistical environment. ● Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions.	3 Hours
5.	Densities of Random Variables ● Off the Shelf Distributions in R ● Matching a Density to Data ● More About Making Histograms	3 Hours
6	Binomial Distribution ● Study of binomial distribution. ● Plots of density and distribution functions. ● Normal approximation to the Binomial distribution	3 Hours
7	Building Confidence in Confidence Intervals ● Populations Versus Samples ● Large Sample Confidence Intervals ● Simulating Data Sets ● Evaluating the Coverage of Confidence Intervals	3 Hours
8	Perform Tests of Hypotheses ● Perform tests of hypotheses about the mean when the variance is known. ● Compute the p-value.	3 Hours

	● Explore the connection between the critical region, the test statistic, and the p-value	
9	Correlation ● Calculate the correlation between two variables. ● Make scatter plots. ● Use the scatter plot to investigate the relationship between two variables.	3 Hours
10	Estimating a Linear Relationship ● A Statistical Model for a Linear Relationship ● Least Squares Estimates ● The R Function lm ● Scrutinizing the Residuals	3 Hours
	Total Laboratory Hours	**30 hours**
Text Book(s)		
1.	Maria Dolores Ugarte , Ana F. Militino , Alan T. Arnholt, "Probability and Statistics with R", 2016, Second Edition, CRC Press	
Reference Books		
1.	Michael Akritas, "Probability & Statistics with R for Engineers and Scientists", 2016, Second Edition on, CRC 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
UBCA408L	Image Processing	3	0	0	3
Pre-requisite		Syllabus version			
		v.1.0			

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:

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	Introduction Image Processing	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	Digital Image Fundamentals	6 Hours

Image Sampling and Quantization, Representing Digital Images, Spatial and Intensity Resolution, and Image Interpolation- The basic relationship between pixels

Module:3	Intensity Transformations and Spatial Filtering	6 Hours

Intensity Transformation Functions - Histogram Processing – Spatial Filtering, Spatial Correlation and Convolution- Smoothing and Sharpening of Spatial Filters

Module:4	Filtering in the Frequency Domain	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

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", 2020,Second Edition, MC Graw Hill.

2.	Anil K Jain, "Fundamentals of Digital Image Processing", 2015, First Edition, Prentice Hall.		
3.	William K. Pratt, "Digital Image Processing", 2014, First Edition, 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

Course Code	Course Title	L	T	P	C
UBCA408P	Image Processing Lab	0	0	2	1
Pre-requisite		**Syllabus Version**			
		v.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 and 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	2Hours
2.	Implementation of point process techniques	2Hours
3.	Implementation of spatial domain smoothing and sharpening techniques	4Hours
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" , 2020,Second Edition, MC Graw Hill.

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
UBCA409L	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

Course Code	Course Title	L	T	P	C
UBCA409P	**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 (India).

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
UBCA410L	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. 72	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UBCA411L	Artificial Intelligence	3	0	0	3
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 - 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		
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		
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		
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		
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		
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		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Deepak Khemani, "A First Course in Artificial Intelligence", 2017, First Edition, McGraw Hill.

Reference Books			
1.	Stuart Russell and Peter Norvig,"Artificial Intelligence: A Modern Approach," 2022, Fourth 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

COGNITIVE SYSTEMS COURSES

Course Code	Course Title	L	T	P	C
UCSC215L	Infrastructure Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v.1.0			

Course Objectives:

1. To learn the basics of infrastructure management and configuration of devices
2. To acquire knowledge on the usage of System Center Configuration Manager and System Center Operations Manager Overview

Course Outcomes:

1. Familiarize the basic concepts of managing the Windows 10 client OS 2.
2. Explore the System Center Configuration Manager for systems management
3. Recognize the procedure for troubleshooting with SCCM
4. Summarize the usage of System Center Operations Manager for systems monitoring.
5. Understand the concepts related to troubleshooting with SCOM

Module:1	Windows 10 Client OS	7 hours

Introducing Windows 10 - Overview of Deploying Windows 10 - Configure Devices and Drivers - Perform Post installation Configuration Tasks - Managing Apps in Windows

Module:2	Introduction to SCCM	6 hours

System Center Configuration Manager Overview - SCCM Features and Capabilities - SCCM Setup & Installation - Configuration Manager Basics - Deploying SCCM Client, User and Device Collections in SCCM

Module:3	Managing Systems with SCCM	6 hours

Application Management using SCCM - Operating System Deployment using SCCM - Endpoint Protection using SCCM

Module:4	Troubleshooting with SCCM	6 hours

Troubleshooting SCCM Server - Troubleshooting SCCM Clients - Creating Reports using SCCM Reports

Module:5	Introduction to SCOM	6 hours

System Center Operations Manager Overview - SCOM Features and Capabilities - SCOM Setup & Installation - Operations Manager Basics - Deploying SCOM Clients, Management Packs in SCOM		
Module:6	**Monitoring Systems with SCOM**	**6 hours**
Managing & Administering SCOM Environment, Managing Alerts using SCOM, Creating Custom Management Packs and Alerts		
Module:7	**Troubleshooting with SCOM**	**6 hours**
Troubleshooting SCOM Server, Troubleshooting SCOM Clients, Creating Reports using SCOM Reporting		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Woody Leonhard, Windows 10 All-in-One For Dummies, Wiley Publisher, First Edition, 2015.

Reference Books

1.	Kerrie Meyler, Gerry Hampson, Saud Al-Mishari, Greg Ramsey, Kenneth van Surksum, Michael Gottlieb Wiles, System Center Configuration Manager Current Branch Unleashed, Pearson Publisher, First edition, 2018
2.	Kevin Greene, Getting Started with Microsoft System Center Operations Manager, Packt publishing, First edition, 2016

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
UCSC215P	Infrastructure Management Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		v.1.0			

Course Objectives:

1. To learn the basics of infrastructure management and configuration of devices 2. To acquire knowledge on the usage of System Center Configuration Manager and System Center Operations Manager Overview

Course Outcomes:

1. Familiarize the basic concepts of managing the Windows 10 client OS
2. Recognize the procedure for troubleshooting with SCCM .
1. Understand the concepts related to troubleshooting with SCOM.

Indicative Experiments

1.	Deployment Overview of Windows 10
2.	Installation of SCCM Server
3.	Deployment of SCCM Agents
4.	Software Deployment using SCCM
5.	Generate Reports for SCCM
6.	Installation of SCOM Server
7.	Deployment of SCOM Agents
8.	Deployment and Customization of Management Packs in SCOM
9.	Create Alerts and Notifications using SCOM
	. Generate Reports for SCOM
	Total Lecture hours: 30 hours

Text Book(s)	
1.	Woody Leonhard, Windows 10 All-in-One For Dummies, Wiley Publisher, First Edition, 2015. Link :
2.	https://techkingeducon.files.wordpress.com/2019/08/windows-10-all-in-one-for dummies.pdf
Reference Books	
1.	Kerrie Meyler, Gerry Hampson, Saud Al-Mishari, Greg Ramsey, Kenneth van Surksum, Michael Gottlieb Wiles, System Center Configuration Manager Current Branch Unleashed, Pearson Publisher, First edition, 2018
2.	Kevin Greene, Getting Started with Microsoft System Center Operations Manager, Packt publishing, First edition, 2016

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
UCSC322L	IT Infrastructure	3	1	0	4
Pre-requisite	NIL	Syllabus version			
		v.1.0			

Course Objectives:

1. To acquire knowledge on ITIL 4 usage and its benefits in IT infrastructure
2. To learn the key concepts of ITIL 4 key concepts of service management and service value systems.

Course Outcomes:

1. Understand the basics of ITIL 4 and its framework
2. Summarize the key concepts of service management
3. Explore ITIL 4 dimensional model for IT service management
4. Familiarize the ITIL service value system along with guiding principles and governance
5. Recognize the practices for ITIL management services

Module:1	Introduction to ITIL 4	7 hours

IT Service Management in the modern world - About ITIL v4 - The structure and benefits of the ITIL v4 Framework

Module:2	Key Concepts of Service Management	7 hours

Value and Value Co-Creation, Stakeholders -Products and Services - Service Relationships and Value

Module:3	ITIL 4 Dimension Model of IT Service Management	7 hours

Organization & People - Information & Technology - Partners & Suppliers

Module:4	ITIL Considerations	7 hours

Value Streams & Processes - External factors

Module:5	ITIL Service Value System	7 hours

Service Value System (SVS) Overview – Opportunity, demand, and Value - Guiding Principles – Governance

Module:6	ITIL Service Value Chain	4 hours

Service Value Chain (SVC) - Continual Improvement – Practices		
Module:7	**ITIL Management Practices**	**4 hours**
General Management Practices - Service Management Practices - Technical Management Practices		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours: **Total Tutorial Hours:**	**45 hours** **15 hours**

Text Book(s)

1.	Clyde Bank Technology, ITIL For Beginners: The Complete Beginner's Guide to ITIL, ClydeBank Media LLC, First edition, 2017

Reference Books

1.	Axelos, ITIL Foundation: ITIL 4 Edition, IT Governance Publishing, Fourth edition, 2019
2.	Peter Farenden , ITIL For Dummies, John Wiley & Sons; 2011th edition, 2012

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
UCSC323L	**Process Management**	**3**	**1**	**0**	**4**
Pre-requisite	**Nil**	**Syllabus version**			
		V 1.0			

Course Objectives:

1. To Understand the software process, practice, and process model.
2. To Apply process in agile process model, and agile framework process.
3. To Learn the process work of scrum, DevOps, and design thinking in real time software projects.

Course Outcomes:

1. Identify the fundamentals of process management and software process models
2. Examine the functionality of agile process model and framework process 3.Analyze the working functionality of scrum, DevOps.
4. Exhibit the knowledge of design thinking.
5. Exercise the real-time applications of process management.

Module: 1	Introduction to software Engineering	4 hours

The Nature of Software, The Unique Nature of Web Apps, Software Engineering Software Process, Software Engineering Practice-Software Myths. Software Process

Module: 2	Software Process Model	7 hours

A Generic Process Model- Process Assessment and Improvement- Perspective Process Models-Specialized Process Model,-The Unified Process- Software Engineering Code of Ethics.

Module: 3	Introduction to Agile	5 hours

What Is Agile,-Understanding Agile Value,-Agile Manifesto-Principles of Agile-Agile Methodologies-Advantages and Disadvantages of Agile.

Module: 4	Agile Framework	6 hours

Agile anti-patterns-Scaled Agile Framework-Why Lean UX-The Three Foundations of Lean UX-Principles of Lean UX.

Module: 5	Scrum	7 hours

Definition of Scrum-Uses of Scrum-Scrum Theory-Scrum Values-The Scrum Team- Scrum Events-Scrum Artifacts-Artifact Transparency.		
Module:6	**DevOps**	**7 hours**
Introduction to DevOps- methodologies- principles,-strategies,-Automation- Performance Measurement through KPIS and Metrics- Agile and DevOps- Agile Infrastructure- Velocity- Lean Startup UPS.		
Module:7	**Design Thinking**	**7 hours**
Introduction to Design Thinking – Lean thinking, Actionable Strategy, The Problem with Complexity, Vision and Strategy,-Defining Actionable Strategy Act to Learn -Leading Teams to Win.		
Module:8	**Contemporary Topics**	**2 hours**
Guest lectures from Industry and, Research and Development Organizations		
	Total Lecture hours: **Total Tutorial Hours:**	**45 hours** **15 hours**

Text Book(s)

1.	Roger S Pressman, "Software Engineering a Practitioner's Approach", McGraw-Hill ,7th Edition 2010.
2.	Ian sommervIlle ,"Software engineering" Pearson ,9th edition 2017.

Reference Books

1.	Andrew Stellman & Jennifer Greene, Learning Agile, O'Reilly Media, First Edition, 2014
2.	Ken Schwaber and Jeff Sutherland, The Scrum Guide, 2017

Mode of Evaluation: CAT, Written Assignment, Quiz, 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
UCSC324L	**Customer Relationship Management**	**3**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Syllabus version**			
		V 1.0			

Course Objectives:

1. To Understand the nuances of customer relationship management.
2. To Familierse with tasks and workflows and examine the data policies.
3. To Examine the functionality of administration and security activities.

Course Outcome:

1. Identifying the interface modules and user interface settings.
2. Explore the User interface customization principles and data Relationships concepts.
3. Examine the process of tasks and workflow process.
4. Apply the User Interface data policies" In Digital Technologies.
5. Exhibit the operation of automation anywhere platform.

Module: 1	**The Interface**	**6 hours**

Versions- Frames- Important application menus and modules-Content Frame-UI Settings and Personalization-Lists and Forms – List V2 versus List V3, Lists and Tables, Forms.

Module: 2	**UI Customization**	**7 hours**

Branding your Instance- Custom Themes-UI-Impacting System Properties- Configuring Service Portal UI-creating a Custom Homepage-Styling Pages and Widgets- setting up the War Room page,-Styling the CMS.

Module: 3	**Understanding Data and Relationships**	**6 hours**

One to many relationships in ServiceNow,-many to many relationships in ServiceNow-enforcing one to one relationship-Defining Custom Relationships-Database table inheritance

Module: 4	**Tasks and Workflows**	**6 hours**

Important Task fields-Journals, and the activity formatter- Extending the task table-Workflows-SLA- Approvals= Assignment- Creating Task fields.

Module: 5	**UI and Data Policies**	**6 hours**
UI Policies- Reverse if false- Scripting in UI policies-UI Policy Order-Data Policies-Converting between data and UI Policies-Data Policies versus ACLs.		
Module:6	**User Administration and Security**	**6 hours**
Users, Groups and Roles-Emails and Notifications- User Preferences-ACLs – Security Rules.		
Module:7	**Introduction to Scripting**	**6 hours**
Client-side versus Server-side APIs- where scripting is supported- Integrated development environment.		
Module:8	**Contemporary Topics**	**2 hours**
Guest lectures from Industry and, Research and Development Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Tom Woodfuff," Learning ServiceNow: administration and development on the Now platform, for powerful IT automation", 2018.

Reference Books

1.	Buttle Francis ,"Customer Relationship Management: Concepts and Technologies", 2ed Edition, January 2009.

Mode of Evaluation: CAT, Written Assignment, Quiz, 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
UCSC324P	**Customer Relationship Management Lab**	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To equip students with the knowledge about Customer relationship management.
2. To provide experience in applying real time tools in user interface with practical problems.

Course Outcomes:

1. Use appropriate algorithms for the navigation interface process.
2. Understand complexity of managing and creating lists and records.
3. Capable of performing experiments in user interface using real-world data.

	Indicative Experiments	Hours
1.	Basic Navigation a. Navigation and the User Interface b. Navigating Applications c. Introduction to Searching	12 Hours
2	Managing Records in Lists a. Using Lists b. Finding Information in Lists c. Using Filters and Breadcrumbs d. Editing Lists e. Creating Personal Lists	12 Hours
3	Managing Records in Forms	6 Hours
	Total Laboratory Hours	**30 hours**

Book(s)

1. Tom Woodfuff," Learning ServiceNow: administration and development on the Now platform, for powerful IT automation". 2018

2. Buttle Francis ,"Customer Relationship Management: Concepts and Technologies", 2ed Edition, January 2009.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	01-11-2023		
Approved by Academic Council	No. 70	Date	13-12-2023

Course Code	Course Title	L	T	P	C
UCSC325L	**Digital Technologies**	**3**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Syllabus version**			
		V 1.0			

Course Objectives:

1. To Understand the importance of the digital world and advancement in digital industries.
2. To Examine the digital applications using RPA.
3. To Apply the functionality of automation tools in digital platform

Course Outcomes:

1. Identifying the need of digital technologies and learning advancement in the digital world.
2. Examine the functionality of digital in industries and communication world. 3.Apply the design principles of RPA
3. .Demonstrate the real time application of RPA
4. Exhibit the operation of automation anywhere technology.

Module: 1	**Digital Primer**	**6 hours**

Why is Digital Different,-Digital Metaphors- On Cloud 9- A Small Intro to Big Data- social media & Digital Marketing.

Module: 2	**Advancement of Digital**	**5 hours**

Artificial Intelligence-Unchain the Blockchain, Internet of Everything-Immersive Technology.

Module: 3	**Digital for Industries**	**6 hours**

Manufacturing and Hi-tech-Banking and Financial Services- Insurance and Healthcare- Retail-Travel & Hospitality.

Module: 4	**Digital for communication**	**5 hours**

. Communications-Media & Information Services and Government.

Module: 5	**Art of RPA**	**7 hours**

Introduction - Setting the Context, RPA Prelude, RPA Demystified, RPA vs BPM, RPA Implementations.		
Module:6	**RPA in Industries**	**6 hours**
RPA in Industries- RPA Tools, Cognitive RPA- Automatix.		
Module:7	**Automation Anywhere**	**8 hours**
Getting Started with AA Enterprise-Exploring AA Enterprise, AA Enterprise – Architecture-Knowing the Bots-More About TaskBots-AA Enterprise - Assess your Learning- All About Recorders, Designers, MetaBots		
Module:8	**Contemporary Topics**	**2 hours**
Guest lectures from Industry and, Research and Development Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Vaibhav Srivastava ,"Getting started with RPA using Automation Anywhere: Automate your day-to-day Business Processes using Automation Anywhere"

Reference Books

1.	Arun Kumar Asokan and Nandan Mullakara ,"Robotic Process Automation Projects: Build Real-world RPA Solutions Using UiPath and Automation Anywhere"

Mode of Evaluation: CAT, Written Assignment, Quiz, 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
UCSC352P	**Digital Technologies Lab**	0	0	2	1
Pre-requisite		**Syllabus version**			
		v.1.0			

Course Objectives:

1. To equip students with knowledge about digital technologies .
2. To provide experience in applying real time tools in digital technologies .

Course Outcomes:

1. Use appropriate algorithms and methods for the Automatix(RPA) process.
2. Understand complexity of managing and automation anywhere technology

	Indicative Experiments	Hours
1.	· Automatix (RPA)	15 Hours
2	· Automation Anywhere	15 Hours
	Total Laboratory Hours	**30 hours**

Book(s)

1. Vaibhav Srivastava ,"Getting started with RPA using Automation Anywhere: Automate your day-to-day Business Processes using Automation Anywhere".
2. Arun Kumar Asokan and Nandan Mullakara ,"Robotic Process Automation Projects: Build Real-world RPA Solutions Using UiPath and Automation Anywhere".

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
UCSC225L	Cyber Security	3	0	0	3
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives:

3. To understand key terms and concepts in cyber-attacks, security issues, associated vulnerabilities.
4. To exhibit knowledge to secure systems, protect personal data, Phishing and Identity Theft using software or tools.
5. To emphasis principles of governance, regulatory, legal, economic, environmental, social and ethical contexts of cyber security.

Course Outcomes:

7. Develop a deeper understanding and familiarity with various types of cyberattacks, cybercrimes, vulnerabilities and need of cyber security
8. Apply critical thinking and problem-solving skills to detect the vulnerabilities and safety against cyber-frauds
9. Enhance information security in the development process and infrastructure protection
10. Understand modern concepts related to Intrusion Detection/ Prevention System
11. Design operational cyber security strategies and policies based on Legal perspective

Module:1	**Introduction to Cyber and Cyber offenses-Ch1,2**	**6 hours**

Definition and Scope - Classifications of Cybercrimes –Email Spoofing, Spamming, Data Diddling, web jacking, Hacking, Software Piracy, Computer network intrusions, password sniffing - Cyber Offenses - Categories of Cybercrime - Social Engineering, Cyber Stalking, Cyber Cafe - Bot Nets - Attack Vector

Module:2	**Cybercrime - Mobile and Wireless devices-Ch3**	**6 hours**

Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era - Security Challenges Posed by Mobile Devices - Authentication Service Security - Attacks on Mobile Phone - Organizational Measures and Security Policies - Identity and Access Management - Architecture - IAM Standards

Module:3	**Tools and Methods in Cybercrime-Ch4**	**6 hours**

Introduction – Proxy servers and Anonymizers - Password Cracking - Keyloggers and Spywares - Viruses and Worms - Trojan Horses and Backdoors - Steganography - DoS and DDoS Attacks - SQL Injection - Buffer Overflow - Attacks on Wireless Networks

Module:4	**Phishing and Identity Theft-Ch5**	**6 hours**

Phishing - Methods and Techniques - Spear Phishing - Types of Phishing - Phishing Toolkit - Spy Phishing - Phishing Countermeasures - Identity Theft - Personal Identifiable Information - Types and Techniques – Countermeasures - Case Study - Identify Theft

Module:5	**Cyber Threats and Their Defense-Ch26-R2**	**6 hours**

Domain Name System Protection - Router Security - Spam/Email Defensive Measures - Web-Based Attacks Protection - Database Defensive Measures - Botnet Attacks and Applicable Defensive Techniques

Module:6	**Intrusion Detection/Prevention System -Ch19-R2**	**6hours**

Anomaly-Based Detection Methods - Signature-Based IDS/IPS - Adaptive Profiles - Network-Based IDS/IPS - Host-Based IDS/IPS – Honeypots - The Detection of Polymorphic/Metamorphic Worms - Distributed Intrusion Detection Systems and Standards – SNORT - The Tipping Point IPS - The Security Community's Collective Approach to IDS/IPS

Module:7	**Legal Perspectives-ch8,10**	**7 hours**
The Legal Perspectives - Need of Cyberlaw - - The Indian IT Act - Challenges and Consequences - Digital Signature and the Indian IT Act - Amendments to the Indian IT Act - Cybercrime and Punishment – Cyberlaw - IPR Issues - Web Threats - Security and Privacy Implications - Protecting People's Privacy Media and Asset Protection - End Point Security - Case Study		
Module:8	**Contemporary Topics**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Nina Godbole, Sunit Belapure, "Cyber Security - Understanding Cybercrimes, Computer Forensics and Legal Perspectives", 2018,First Edition, Wiley.
Reference Books	
1.	CJames Graham, Richard Howard, Ryan Olson, "Cybersecurity Essentials",2018, First Edition, CRC Press.
2.	Chwan-Hwa (John) Wu J. David Irwin, "Networks and Cybersecurity", 2013, CRC Press

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