THIRUVALLUVAR UNIVERSITY

SERKKADU, VELLORE–632115

M.Sc. COMPUTER SCIENCE

SYLLABUS

FROM THE ACADEMIC YEAR
2023 – 2024

CONTENTS

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.Sc., Computer Science**
Programme Code	
Duration	**PG - Two Years**
Programme Outcomes (Pos)	**PO1 : Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2 : Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3 : Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4 : Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5 : Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6 : Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7 : Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8 : Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO9 : Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO10 : Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one's life.

Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

METHODS OF EVALUATION FOR THEORY SUBJECTS		
Internal Evaluation	Continuous Internal Assessment Test	**25 Marks**
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	**75 Marks**
Total		**100 Marks**
METHODS OF EVALUATION FOR PRACTICAL SUBJECTS		
Internal Evaluation	Preparation for the Practical Session	**40 Marks**
	Executing an Exercise within the Stipulated Time	
	Continuous Internal Practical Tests	
	Completing All the Exercises of the Course	
External Evaluation	Coding / Solutions for the Two Problems	**50 Marks**
	Preparation of the Record	**10 Marks**
Total		**100 Marks**

METHODS OF ASSESSMENT	
Remembering (K1)	• The lowest level of questions requires student store call information from the course content. • Knowledge questions usually require students to identify information in the textbook.
Understanding (K2)	• Understanding of f acts and ideas by comprehending organizing, comparing, translating, interpolating, and interpreting in their own words. • The questions go beyond simple recall and require students to combine data together.
Application (K3)	• Students must solve problems by using / applying a concept learned in the classroom. • Students must use their knowledge to determine an exact response.
Analyze (K4)	• Analyzing the question is one that asks the students to breakdown something into its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged in decision-making and problem–solving. • Evaluation questions do not have single right answers.
Create (K6)	• The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem-solving skills.

PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING

PROGRAMME SPECIFIC OUTCOMES (PSO)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
PSO1	**3**	**3**	**3**	**3**	**3**
PSO2	**3**	**3**	**3**	**3**	**3**
PSO3	**3**	**3**	**3**	**3**	**3**
PSO4	**3**	**3**	**3**	**3**	**3**
PSO5	**3**	**3**	**3**	**3**	**3**

Level of Correlation between PO's and PSO's

(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)

Assign the value.
1 – Low
2 – Medium
3 – High
0 – No Correlation

M.Sc., Computer Science

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
Core - I	Analysis and Design of Algorithms	5	7	-	25	75	100
Core – II	Object Oriented Analysis and Design & C++	5	7	-	25	75	100
Core – III	Python Programming	4	6	-	25	75	100
Elective - I	Advanced Software Engineering / Principles of Compiler Design	3	5	-	25	75	100
Elective – II	Algorithm and OOPS Lab / Python Programming Lab	3	-	5	40	60	100
	Total	**20**	**25**	**5**			**500**
SECOND SEMESTER							
Core - IV	Data Mining and Warehousing	5	5	-	25	75	100
Core – V	Advanced Operating Systems	5	5	-	25	75	100
Core - VI	Advanced Java Programming	4	6	-	25	75	100
Elective – III	Artificial Intelligence and Machine Learning / Web Services	3	4	-	25	75	100
Elective – IV	Advanced Java Programming Lab / Web Application Development and Hosting Lab	3	-	4	40	60	100
SEC-I	Data Mining using R Lab	2	-	4	40	60	100
	Fundamentals of Human Rights	2	2	-	25	75	100
	MOOC Course	2	-	-	-	-	-
	Total	**26**	**22**	**8**			**700**

THIRD SEMESTER							
Core - VII	Digital Image Processing	5	6	-	25	75	100
Core – VIII	Paper X : Cloud Computing	5	5	-	25	75	100
Core – IX	Network Security and Cryptography	5	5	-	25	75	100
Core - X	Data Science and Analytics	4	6	-	25	75	100
Elective – V	Digital Image Processing Lab using MATLAB / Network Security and Cryptography Lab	3	-	4	40	60	100
SEC-II	Cloud Computing Lab	2	-	4	40	60	100
Internship	Internship Industrial Activity	2	-	-	40 -	60	100
	Total	**26**	**22**	**8**			**700**
FOURTH SEMESTER							
Core – XI	Internet of Things	5	6	-	25	75	100
Core – XII	Block Chain Technology	5	6	-	25	75	100
Core - XIII	Project Work and Viva-Voce	7	-	10	80	120	200
Elective - VI	Industry Entrepreneurship : Internet of Things Lab / Block Chain Technologies Lab	3	-	4	40	60	100
SEC-III	Skill Enhancement Course : Soft Skill Development Lab / Professional Competency Skill : Data Visualisation Lab	2	-	4	40	60	100
	Extension Activity	1	-	-	-	-	-
	Total	**23**	**12**	**18**			**600**
	Grand Total	**95**					

I – SEMESTER

Course code		ANALYSIS AND DESIGN OF ALGORITHMS	L	T	P	C
Core/Elective/Supportive		Core	7			5
Pre-requisite		Basic Data Structures & Algorithms				

Course Objectives :

The main objectives of this course are to :

1. Enable the students to learn Elementary Data Structures and algorithms.
2. Presents an introduction to the algorithms, their analysis and design.
3. Discuss various methods like Basic Traversal and Search Techniques, Divide and Conquer method, Dynamic programming, backtracking.
4. Understood the various design and analysis of the algorithms.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Get knowledge about algorithms and determine their time complexity. Demonstrate specific search and sort algorithms using divide and conquer technique.	K1,K2
2	Gain good understanding of Greedy method and its algorithm.	K2,K3
3	Able to describe about graphs using dynamic programming technique.	K3,K4
4	Demonstrate the concept of backtracking & branch and bound technique.	K5,K6
5	Explore the traversal and searching technique and apply it for trees and graphs.	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	20 Hours

Introduction: - Algorithm Definition and Specification – Space complexity-Time Complexity-Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heapsort- Graph.

Unit:2	TRAVERSAL AND SEARCH TECHNIQUES	20 Hours

Basic Traversal and Search Techniques: Techniques for Binary Trees-Techniques for Graphs - Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort.

Unit:3	GREEDY METHOD	20 Hours

The Greedy Method :- General Method–Knapsack Problem–Minimum Cost Spanning Tree– Single Source Shortest Path.

Unit:4	DYNAMIC PROGRAMMING	20 Hours
Dynamic Programming-General Method–Multistage Graphs–All Pair Shortest Path–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.		

Unit:5	BACK TRACKING	20 Hours
Back tracking:-General Method–8-Queens Problem–Sum Of Subsets–Graph Coloring–Hamiltonian Cycles – Branch And Bound: - The Method – Traveling Salesperson.		

Unit:6	Contemporary Issues	5 Hours
Expert lectures, online seminars – webinars		

	Total Lecture Hours	105 hours

Text Books

1	Ellis Horowitz, “Computer Algorithms”, Galgotia Publications.
2	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, " Data Structures and Algorithms".

Reference Books

1	Goodrich, “Data Structures & Algorithms in Java”, Wiley 3rd edition.
2	Skiena,” The Algorithm Design Manual”, Second Edition, Springer, 2008
3	Anany Levith,” Introduction to the Design and Analysis of algorithm”, Pearson Education Asia, 2003.
4	Robert Sedgewick, Phillipe Flajolet,” An Introduction to the Analysis of Algorithms”, Addison-Wesley Publishing Company,1996.

Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/106/106106131/
2	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
3	https://www.javatpoint.com/daa-tutorial

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	L	M	L	S	M
CO2	S	S	S	S	S	M	S	M	S	M
CO3	S	S	S	S	S	M	S	M	S	M
CO4	S	S	S	S	S	M	S	M	S	M
CO5	S	S	S	S	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code		OBJECT ORIENTED ANALYSIS AND DESIGN & C++	L	T	P	C
Core/Elective/Supportive		Core	7			5
Pre-requisite		Basics of C++and Object-Oriented Concepts				

Course Objectives :

The main objectives of this course are to:

1. Present the object model, classes and objects, object orientation, machine view and model management view.
2. Enables the students to learn the basic functions, principles and concepts of object-oriented analysis and design.
3. Enable the students to understand C++ language with respect to OOAD.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the concept of Object-Oriented development and modeling techniques	K1,K2
2	Gain knowledge about the various steps performed during object design	K2,K3
3	Abstract object-based views for generics of Software systems	K3
4	Link OOAD with C++ language	K4,K5
5	Apply the basic concept of OOPs and familiarize to write C++ program	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	OBJECT MODEL	20 Hours

The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. Classes and Objects: The Nature of an Object – Relationship among Objects**.**

Unit:2	CLASSES AND OBJECTS	20 Hours

Classes and Object: Nature of Class – Relationship Among classes – The Interplay of classes and Objects. Classification: The importance of Proper Classification –identifying classes and objects – Key Abstractions and Mechanism.

Unit:3	C++ INTRODUCTION	20 Hours

Introduction to C++-Input and output statements in C++-Declarations-control structures– Functions in C++.

Unit:4	**INHERITANCE AND OVERLOADING**	**20 Hours**
Classes and Objects–Constructors and Destructors–operators overloading–Type Conversion-Inheritance – Pointers and Arrays.		

Unit:5	**POLYMORPHISM AND FILES**	**20 Hours**
MemoryManagementOperators-Polymorphism–Virtualfunctions–Files–Exception Handling – String Handling -Templates.		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**105 Hours**

Text Books	
1	"Object Oriented Analysis and Design with Applications", Grady Booch, Second Edition, Pearson Education.
2	"Object-Oriented Programming with ANSI &Turbo C++", Ashok N. Kamthane, First Indian Print -2003, Pearson Education.
Reference Books	
1	Balagurusamy,"Object Oriented Programming with C++",TMH, Second Edition,2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	M	S	M	S	S
CO2	S	S	S	M	S	M	S	M	S	S
CO3	S	S	S	M	S	M	S	M	S	S
CO4	S	S	S	M	S	M	S	M	S	S
CO5	S	S	S	M	S	M	S	M	S	S

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code		PYTHON PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	4			6
Pre-requisite		Basics of any OO Programming Language				

Course Objectives :

The main objectives of this course are to :

1. Presents an introduction to Python, creation of web applications, network applications and working in the clouds.
2. Use functions for structuring Python programs.
3. Understand different Data Structures of Python.
4. Represent compound data using Python lists, tuples and dictionaries.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the basic concepts of Python Programming	K1,K2
2	Understand File operations, Classes, and Objects	K2,K3
3	Acquire Object Oriented Skills in Python	K3,K4
4	Develop web applications using Python	K5
5	Develop Client Server Networking applications	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	17 Hours

Python : Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets– Comparison.

Unit:2	CODE STRUCTURES	17 Hours

Code Structures : if, elseif, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions.

Unit:3	MODULES, PACKAGES AND CLASSES	17 Hours

Modules, Packages, and Programs: Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. **Objects and Classes:** Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent with super–Inself Defense –Get and Set Attribute Values with Properties –Name Mangling for Privacy – Method Types – Duck Typing – Special Methods –Composition.

Unit:4	DATA TYPES AND WEB	17 Hours
Data Types : Text Strings–Binary Data, **Storing and Retrieving Data:** File Input/Output–Structured Text Files – Structured Binary Files - Relational Databases – NoSQL Data Stores. **Web :** Web Clients –Web Servers–Web Services and Automation		

Unit:5	SYSTEMS AND NETWORKS	17 Hours
Systems : Files–Directories–Programs and Processes–Calendars and Clocks. **Concurrency:** Queues– Processes–Threads–Green Threads and gevent–twisted–Redis. **Networks:** Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – Zero MQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and MapReduce – Working in the Clouds.		

Unit:6	Contemporary Issues	5 Hours
Expert lectures, online, seminars – webinars		

	Total Lecture Hours	90 Hours

Text Books

1	Bill Lubanovic, “Introducing Python”, O’Reilly, First Edition-Second Release, 2014.
2	Mark Lutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.

Reference Books

1	David M. Beazley, “Python Essential Reference”, Developer’s Library, Fourth Edition,2009.
2	Sheetal Taneja, Naveen Kumar, “Python Programming-A Modular Approach”, Pearson Publications.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	M
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	S	M
CO5	S	S	S	S	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code		ADVANCED SOFTWARE ENGINEERING	L	T	P	C
Core/Elective/Supportive		Elective	5			3
Pre-requisite		Basics of Software Engineering & SPM				

Course Objectives :

The main objectives of this course are to :

1. Introduction to Software Engineering, Design, Testing and Maintenance.
2. Enable the students to learn the concepts of Software Engineering.
3. Learn about Software Project Management, Software Design & Testing.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand about Software Engineering process	K1,K2
2	Understand about Software project management skills, design and quality management	K2,K3
3	Analyze on Software Requirements and Specification	K3,K4
4	Analyze on Software Testing, Maintenance and Software, Re-Engineering	K4,K5
5	Design and conduct various types and levels of software quality for a software project	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	14 Hours

Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes.

Unit:2	SOFTWARE REQUIREMENTS	14 Hours

Software Requirements Analysis and Specification : Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Result management system. Software Quality Management –Software Quality, Software Quality Management System, ISO 9000, SEI CMM.

Unit:3	PROJECT MANAGEMENT	14 Hours

Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead‟s software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.

Unit:4	SOFTWARE DESIGN	14 Hours
Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.		
Unit:5	**SOFTWARE TESTING**	**14 Hours**
Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging– Testingtools-Metrics-ReliabilityEstimation.SoftwareMaintenance -Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars –webinars		
	Total Lecture Hours	**75 Hours**

Text Books	
1	An Integrated Approach to Software Engineering–Pankaj Jalote, Narosa Publishing House, Delhi, 3rd Edition.
2	Fundamentals of Software Engineering –Rajib Mall, PHI Publication,3rdEdition.
Reference Books	
1	Software Engineering–K.K.Aggarwal and Yogesh Singh, New Age International Publishers, 3rd edition.
2	A Practitioners Approach – Software Engineering, R.S.Pressman, McGraw Hill.
3	Fundamentals of Software Engineering - Carlo Ghezzi, M. Jarayeri, D. Manodrioli, PHI Publication.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/software-engineering-tutorial
2	https://onlinecourses.swayam2.ac.in/cec20_cs07/preview
3	https://onlinecourses.nptel.ac.in/noc19_cs69/preview

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code		PRINCIPLES OF COMPILER DESIGN	L	T	P	C
Core/Elective/Supportive		Elective	5			3
Pre-requisite		Basics of Formal Languages and Automata Theory				

Course Objectives :

The main objectives of this course are to :

1. Introducing Grammar, Finite Automata, Parser, Syntax Tree and Code Generation.
2. Enable the students to learn about different phases of Compiler.
3. Learn about Conversion of Source Code to Object Code.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the phases and tools available in Compiler	K2
2	Design and implement a Lexical Analyzer	K3
3	Compare and analyze different types of Compilers	K4
4	Specify appropriate translations to generate Intermediate Code	K3
5	Identify sources for Code Optimization	K4

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION TO COMPILERS	14 Hours

Introduction to Compiling – Compilers – Analysis of the Source Program – Phases of a Compiler. Grouping of Phases – Compiler Construction Tools.

Unit:2	LEXICAL ANALYSIS	14 Hours

Lexical Analysis – Role of the Lexical Analyzer – Specification and Recognition of Tokens – Language for specifying Lexical Analyzer – Finite Automata – Regular Expressions to NFA – Design of Lexical Analyzer Generator – Optimization of DFA based pattern matchers.

Unit:3	SYNTAX ANALYSIS	14 Hours

Syntax Analysis – Role of Parser – Context Free Grammars – Top Down Parsing – Bottom Up Parsing – Operator Precedence Parsing – LR Parsers.

Unit:4	SYNTAX DIRECTED TRANSLATION	14 Hours

Syntax Directed Translation: Syntax Directed Definitions – Construction of Syntax Trees – Bottom Up evaluation of attributed definition – Bottom Up evaluation of inherited attributes – Recursive evaluators.

Unit:5	INTERMIDIATE CODE GENERATION AND OPTIMIZATION	14 Hours
Intermediate Code Generation: Intermediate Languages – Declaration – Assignment Statements. Procedure Calls – Runtime Storage Management. Code Generation and Optimization: Basic Blocks and Flow Graphs – DAG Representation.		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**75 Hours**

Text Books	
1	Compilers – Principles, Techniques and Tools – Alfred Aho, Ravi Sethi, Jeffry D. Ullman, Pearson : 1986
2	Modern Compiler Design – Dick Grune, Bal, Langendoen, Jacobs, Wiley : 2012
3	Compiler Design – K. Muneeswaran, Oxford University Press : 2013
Reference Books	
1	Modern Compiler Design – David Galles, Pearson Education Asia : 2001
2	Advanced Compiler Design and Implementation – Steven S. Muchnick, Morgan Kaufmann Publishers : 2000
3	Crafting a Compiler with C – C.N.Fisher, R.J. Le Blane, Pearson Education : 2000
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.,]	
1	https://www.geeksforgeeks.org/compiler-lexical-analysis
2	https://ieeexplore.ieee.org/document/7779385/
3	https://www.tutorialspoint.com/compiler_design/compiler_design_tutorial.pdf

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	M	-	-	-	-
CO2	S	S	S	M	M	S	-	-	-	-
CO3	S	S	S	S	S	M	-	-	-	-
CO4	S	S	S	S	M	M	-	-	-	-
CO5	S	S	S	M	S	S	-	-	-	-

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code		PRACTICAL : ALGORITHM AND OOPS LAB	L	T	P	C
Core/Elective/Supportive		Elective			5	3
Pre-requisite		Basic Programming of C++ language				

Course Objectives :

The main objectives of this course are to :

1. This course covers the basic data structures like Stack, Queue, Tree, List.
2. Thiscourseenablesthestudentstolearntheapplicationsofthedatastructuresusing various techniques
3. It also enables the students to understand C++ language with respect to OOAD concepts.
4. Application of OOPS concepts.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the concepts of object oriented with respect to C++	K1,K2
2	Able to understand and implement OOPS concepts	K3,K4
3	Implementation of data structures like Stack, Queue, Tree, List using C++	K4,K5
4	Application of the data structures for Sorting, Searching using different techniques.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS — **75 Hours**

1) Write a program to solve the tower of Hanoi using recursion.
2) Write a program to traverse through binary search tree using traversals.
3) Write a program to perform various operations on stack using linked list.
4) Write a program to perform various operations in a circular queue.
5) Write a program to sort an array of elements using quick sort.
6) Write a program to solve number of elements in ascending order using heap sort.
7) Write a program to solve the knapsack problem using a greedy method.
8) Write a program to search for an element in a tree using divide & conquer strategy.
9) Write a program to place the 8 queens on an 8 X 8 matrix so that no two queens Attack.
10) Write a C++ program to perform Virtual Function.
11) Write a C++ program to perform Parameterized constructor.
12) Write a C++ program to perform Friend Function.
13) Write a C++ program to perform Function Overloading.
14) Write a C++ program to perform Single Inheritance.
15) Write a C++ program to perform Employee Details using files.

Total Hours — **75 Hours**

Text Books	
1	Goodrich, "Data Structures & Algorithms in Java",Wiley 3rd edition.
2	Skiena," The Algorithm Design Manual",SecondEdition,Springer,2008
Reference Books	
1	Anany Levith," Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
2	Robert Sedgewick, Phillipe Flajolet," An Introduction to the Analysis of Algorithms", Addison-Wesley Publishing Company,1996.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

I – SEMESTER

Course code		PRACTICAL : PYTHON PROGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Elective			5	3
Pre-requisite		Basics of any OO Programming Language				

Course Objectives :

The main objectives of this course are to:

1. This course presents an overview of elementary data items, lists, dictionaries, sets and tuples.
2. To understand and write simple Python programs.
3. To Understand the OOPS concepts of Python.
4. To develop web applications using Python.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Able to write programs in Python using OOPS concepts	K1,K2
2	To understand the concepts of File operations and Modules in Python	K2,K3
3	Implementation of lists, dictionaries, sets and tuples as programs	K3,K4
4	To develop web applications using Python	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS	75 hours

Implement the following in Python :

1. Programs using elementary data items, lists, dictionaries, and tuples.
2. Programs using conditional branches,
3. Programs using loops.
4. Programs using functions.
5. Programs using exception handling.
6. Programs using inheritance.
7. Programs using polymorphism.
8. Programs to implement file operations.
9. Programs using modules.
10. Programs for creating dynamic and interactive web pages using forms.

Total Hours	75 hours

Text Books	
1	Bill Lubanovic, “Introducing Python”, O’Reilly, First Edition-Second Release, 2014.
2	Mark Lutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.
Reference Books	
1	David M. Beazley, “Python Essential Reference”, Developer’s Library, Fourth Edition,2009.
2	Sheetal Taneja, Naveen Kumar, ” Python Programming-A Modular Approach”, Pearson Publications.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		DATA MINING AND WAREHOUSING	L	T	P	C
Core/Elective/Supportive		Core	5			5
Pre-requisite		Basics of RDBMS & Algorithms				

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the concepts of Mining tasks, classification, clustering, and Data Warehousing.
2. Develop skills of using recent data mining software for solving practical problems.
3. Develop and apply critical thinking, problem-solving, and decision-making skills.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the basic data mining techniques and algorithms	K1,K2
2	Understand the Association rules, Clustering techniques and Data warehousing contents	K2,K3
3	Compare and evaluate different data mining techniques like classification, prediction, Clustering, and association rule mining	K4,K5
4	Design data warehouse with dimensional modeling and apply OLAP operations	K5,K6
5	Identify appropriate data mining algorithms to solve real world problems	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	BASICS AND TECHNIQUES	14 Hours

Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective.

Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.

Unit:2	ALGORITHMS	14 Hours

Classification: Introduction –Statistical –based algorithms -distance–based algorithms-decision tree-based algorithms-neural network–based algorithms–rule-based algorithms–combining techniques.

Unit:3	CLUSTERING AND ASSOCIATION	14 Hours

Clustering: Introduction–SimilarityandDistanceMeasures–Outliers–HierarchicalAlgorithms -Partitional Algorithms.

Association rules: Introduction - large item sets - basic algorithms – parallel &distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules.

Unit:4	DATA WAREHOUSING AND MODELING	14 Hours
Data ware housing: Introduction-characteristics of a data warehouse–data marts–other aspects Of data mart. Online analytical processing: introduction -OLTP & OLAP systems Data modeling –star schema for multidimensional view –data modeling – multifacts schema or snowflake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.		
Unit:5	**APPLICATIONS OF DATA WAREHOUSE**	**14 Hours**
Developing a data WAREHOUSE: why and how to build a data warehouse – data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse. Applications of data warehousing and data mining in government: Introduction - national data warehouses – other areas for data warehousing and data mining.		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**75 Hours**

Text Books

1	Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson education,2003.
2	C.S.R. Prabhu, "Data Warehousing Concepts, Techniques, Products and Applications", PHI, Second Edition.

Reference Books

1	Arun K. Pujari, "Data Mining Techniques", Universities Press (India)Pvt. Ltd.,2003.
2	Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", TMCH, 2001.
3	Jiawei Han & Micheline Kamber, "Data Mining Concepts & Techniques", 2001, Academic press.

Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.javatpoint.com/data-warehouse
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		ADVANCED OPERATING SYSTEMS	L	T	P	C
Core/Elective/Supportive		Core	5			5
Pre-requisite		Basics of OS & its functioning				

Course Objectives:

The main objectives of this course are to :

1. Enable the students to learn the different types of operating systems and their functioning.
2. Gain knowledge on Distributed Operating Systems
3. Gain insight into the components and management aspects of real time and mobile operating systems.
4. Learn case studies in Linux Operating Systems

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the design issues associated with operating systems.	K1,K2
2	Master various process management concepts including scheduling, deadlocks, and distributed file systems	K3,K4
3	Prepare Real Time TaskScheduling	K4,K5
4	Analyze Operating Systems for Handheld Systems	K5
5	Analyze Operating Systems like LINUX and iOS	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	BASICS OF OPERATING SYSTEMS	14 Hours

Basics of Operating Systems: What is an Operating System? – Main frame Systems – Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems – Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments - Process Scheduling – Cooperating Processes – Inter Process Communication - Deadlocks – Prevention – Avoidance – Detection – Recovery.

Unit:2	DISTRIBUTED OPERATING SYSTEMS	14 Hours

Distributed Operating Systems: Issues – Communication Primitives – Lampert's Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda.

Unit:3	REAL TIME OPERATING SYSTEM	14 Hours

Realtime Operating Systems : Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling

Unit:4	HANDHELD SYSTEM	14 Hours
Operating Systems for Handheld Systems : Requirements–Technology Overview–Handheld Operating Systems–Palm OS-Symbian Operating System-Android–Architecture of android–		
Securing handheld systems		
Unit:5	**CASE STUDIES**	**14 Hours**
Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**75 Hours**

Text Books

1	Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.
2	Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.

Reference Books

1	Rajib Mall, "Real-Time Systems : Theory and Practice", Pearson EducationIndia,2006.
2	Pramod Chandra P. Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010.
3	Daniel. P. Bovet & Marco Cesati, "Understanding the Linux kernel",3rdedition, O"Reilly,2005
4	Neil Smyth, "iPhoneiOS4 Development Essentials–Xcode", Fourth Edition, Payload media, 2011.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]

1	https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2	https://www.udacity.com/course/advanced-operating-systems--ud189
3	https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	M	M	M	M
CO2	S	M	S	S	S	S	S	M	S	M
CO3	S	M	S	S	S	S	S	M	S	M
CO4	S	M	S	S	S	S	S	M	S	M
CO5	S	M	S	S	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		ADVANCED JAVA PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	6			4
Pre-requisite		Basics of Java & its Usage				

Course Objectives :

The main objectives of this course are to :

1. Enable the students to learn the basic functions, principles and concepts of advanced java programming.
2. Provide knowledge on concepts needed for distributed Application Architecture.
3. Learn JDBC, Servlet packages, JQuery, Java Server Pages and JAR file format.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the advanced concepts of Java Programming	K1,K2
2	Understand JDBC and RMI concepts	K2,K3
3	Apply and analyze Java in Database	K3,K4
4	Handle different event in java using the delegation event model, event listener and class	K5
5	Design interactive applications using Java Servlet, JSP and JDBC	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	BASICS OF JAVA	17 Hours

Java Basics Review : Components and event handling–Threading concepts–Networking features – Media techniques

Unit:2	REMOTE METHOD INVOCATION	17 Hours

Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons-Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces

Unit:3	DATABASE	17 Hours

Java in Databases-JDBC principles–database access-Interacting-database search–Creating multimedia databases – Database support in web applications

Unit:4	SERVLETS	17 Hours

Java Servlets: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet-Reading data from a client-Reading http request header-sending data to a client and writing the http response header-working with cookies.

Java Server Pages: JSP Overview-Installation-JSP tags-Components of a JSP page-Expressions-Scriptlets-Directives-Declarations-A complete example

Unit:5	**ADVANCED TECHNIQUES**	**17 Hours**
JAR file format creation–Internationalization–Swing Programming–Advanced java techniques		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**90 Hours**

Text Books

1	Jamie Jaworski, "Java Unleashed", SAMS Techmedia Publications,1999.
2	Campione, Walrath and Huml, "The Java Tutorial", Addison Wesley,1999.

Reference Books

1	Jim Keogh," The Complete ReferenceJ2EE", TataMcGrawHill Publishing Company Ltd,2010.
2	David Sawyer McFarland, "Java Script and JQuery-The Missing Manual", Oreilly Publications, 3rd Edition, 2011.
3	Deitel and Deitel, "Java How to Program", Third Edition, PHI/Pearson Education Asia.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	M	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite		Basics of AI & an Introduction about ML				

Course Objectives :

The main objectives of this course are to :

1. Enable the students to learn the basic functions of AI, Heuristic Search Techniques.
2. Provide knowledge on concepts of Representations and Mappings and Predicate Logic.
3. Introducing Machine Learning with respect to Data Mining, Big Data and Cloud.
4. Study about Applications & Impact of ML.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Demonstrate AI problems and techniques	K1,K2
2	Understand machine learning concepts	K2,K3
3	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning	K3,K4
4	Analyze the impact of machine learning on applications	K4,K5
5	Analyze and design of AI world problem for implementation and understand the dynamic behavior of a system	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	11 Hours

Introduction: AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.

Unit:2	SEARCH TECHNIQUES	11 Hours

Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.

Unit:3	**PREDICATE LOGIC**	**11 Hours**
Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules : Procedural Vs Declarative knowledge- Logic programming -Forward Vs Backward reasoning -Matching-Control knowledge.		
Unit:4	**MACHINE LEARNING**	**11 Hours**
Understanding Machine Learning : What Is Machine Learning ?-Defining Big Data-Big Data in Context with Machine Learning-The Importance of the Hybrid Cloud-Leveraging the Power of Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning.		
Unit:5	**APPLICATIONSOFMACHINE LEARNING**	**11 Hours**
Looking Inside Machine Learning : The Impact of Machine Learning on Applications-Data Preparation-The Machine Learning Cycle.		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**60 Hours**

Text Books	
1	Elaine Richand Kevin Knight, "Artificial Intelligence", Tata McGraw Hill Publishers company Pvt Ltd, Second Edition, 1991.
2	GeorgeFLuger,"ArtificialIntelligence",4thEdition, Pearson Education Publ,2002.
Reference Books	
1	Machine Learning for Dummies®, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.ibm.com/downloads/cas/GB8ZMQZ3
2	https://www.javatpoint.com/artificial-intelligence-tutorial
3	https://nptel.ac.in/courses/106/105/106105077/

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		WEB SERVICES	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite		Basics of Dis tributed Computing				

Course Objectives :

The main objectives of this course are to :

1. Present the Web Services, building real world Enterprise applications using Web Services with Technologies XML, SOAP, WSDL, UDDI.
2. Get an overview of Distributed Computing, XML, and its technologies.
3. Update with QoS and its features.
4. Develop Standards and future of Web Services.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand web services and its related technologies	K1,K2
2	Understand XML concepts	K2,K3
3	Analyze on SOAP and UDDI model	K4,K5
4	Demonstrate the road map for the standards and future of web services	K5
5	Analyze QoS enabled applications in web services	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	11 Hours

Introduction to web services – Overview of Distributed Computing- Evolution and importance of web services-Industry standards, Technologies and concepts underlying web services-Web services and enterprises-web services standards organization-web services platforms.

Unit:2	XML FUNDAMENTALS	11 Hours

XML Fundamentals–XML documents-XML Namespaces-XML Schema–Processing XML.

Unit:3	SOAP MODEL	11 Hours

SOAP: The SOAP model- SOAP messages-SOAP encoding- WSDL: WSDL structure- interface definitions-bindings-services-Using SOAP and WSDL-UDDI: About UDDI- UDDI registry Specification- Core data structures-Accessing UDDI

Unit:4	TECHNOLOGIES AND STANDARDS	11 Hours
Advanced web services technologies and standards: Conversations overview-web services conversation language-WSCL interface components. Workflow: business process management-workflows and workflow management systems Security: Basics-data handling and forwarding-data storage-errors-Web services security issues.		

Unit:5	QUALITY OF SERVICE	11 Hours
Quality of Service: Importance of QoS for web services-QoS metrics-holes-design patterns-QoS enabled web services-QoS enabled applications. Web services management-web services standards and future trends.		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**60 Hours**

	Text Books
1	Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services: An Architects Guide", Prentice Hall, Nov 2003.
2	Keith Ballinger, "NET Web services: Architecture and Implementation with .Net", Pearson Education, First Edition, Feb 2003.
	Reference Books
1	Ramesh Nagappan, "Developing Java Web Services : Architecting and developing secure Web Services Using Java", John Wiley and Sons, first Edition Feb 2003.
2	Eric A Marks and Mark J Werrell, "Executive Guide to Web services", John Wiley and sons, March 2003.
3	Anne Thomas Manes, "Web Service s: A managers Guide", Addison Wesley, June 2003.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://www.tutorialspoint.com/webservices/index.htm
2	https://www.javatpoint.com/web-services-tutorial
3	https://www.btechguru.com/training--programming--xml--web-services--web-services-part-1-video-lecture--11801--24--147.html

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	M	S	M	M	M	S
CO2	S	S	S	M	M	S	M	S	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		PRACTICAL : ADVANCED JAVA POGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Elective			4	3
Pre-requisite		Basics in Java Programming				

Course Objectives:

The main objectives of this course are to :

1. To enable the students to implement the simple programs using JSP, JAR
2. To provide knowledge on using Servlets, Applets
3. To introduce JDBC and navigation of records
4. To understand RMI & its implementation
5. To introduce to Socket programming

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand to the implement concepts of Java using HTML forms, JSP & JAR	K1,K2
2	Must be capable of implementing JDBC and RMI concepts	K3,K4
3	Able to write Applets with Event handling mechanism	K4,K5
4	To Create interactive web-based applications using servlets and jsp.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS — **60 Hours**

1. Display welcome message using Servlet.
2. Design a Purchase Order form using Html form and Servlet.
3. Develop a program for calculating the percentage of marks of a student using JSP.
4. Design a Purchase Order form using Html form and JSP.
5. Prepare a Employee pay slip using JSP.
6. Write a program using JDBC for creating a table, Inserting, deleting records and list out the records.
7. Write a program using Java servlet to handle form data.
8. Write a simple Servlet program to create a table of all the headers it receives along with their associated values.
9. Write a program in JSP by using session object.
10. Write a program to build a simple Client Server application using RMI.
11. Create an applet for a calculator application.
12. Program to send a Text message to another system and receive the text message from the system (use socket programming).

Total Hours — **60 Hours**

Text Books	
1	Jamie Jaworski, “Java Unleashed”, SAMS Techmedia Publications,1999.
2	Campione, Walrath and Huml, “The Java Tutorial”, Addison Wesley,1999.
Reference Books	
1	Jim Keogh,” The Complete Reference J2EE”, Tata McGraw Hill Publishing Company Ltd, 2010.
2	David Sawyer McFarland, “Java Script and JQuery – The Missing Manual”, Oreilly Publications, 3rd Edition,2011.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		PRACTICAL : WEB APPLICATION DEVELOPMENT AND HOSTING	L	T	P	C
Core/Elective/Supportive		Core			4	3
Pre-requisite		Basic Programming using HTML tags				

Course Objectives :

The main objectives of this course are to :

1. Able to design a web page using HTML tags.
2. To enable the students to use Frame sets, hyperlinks, and different formatting features of HTML tags.
3. Enable the students to use Forms &other controls on a webpage.
4. To create interactive applications using PHP.

Expected Course Outcomes :

On the successful completion of the course, student twill be able to :

1	Understand & implement the basic HTML tags to create static web pages	K1,K2
2	Capable of using hyperlinks, frames, images, tables,…in a web page	K2,K3
3	Able to write dynamic web applications using HTML forms	K4,K5
4	Must be able to write dynamic web applications in PHP & HTML tags using XAMPP.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

LIST OF PROGRAMS **60 Hours**

1. Develop a website for your college using advanced tags of HTML.
2. Write names of several countries in a paragraph and store it as an HTML document, world.html. Each country's name must be a hot text. When you click India (for example), it must open india.html and it should provide a brief introduction about India.
3. Develop a HTML document to i) display Text with Bullets / Numbers - Using Lists ii) to display the Table Format Data
4. Develop a Complete Web Page using Frames and Framesets which gives the Information about a Hospital using HTML.
5. Write an HTML document to print your Biodata in a neat form using several components.
6. Develop an HTML document to display a Registration Form for an inter-collegiate function.
7. Using HTML form accept Customer details like Name, City, Pin code, Phone number and

Email address and validate the data and display appropriate messages for violations using PHP. (Eg. Name is Mandatory field; Pin code must be 6 digits, etc.).

8. Write a program to accept two numbers n1and n2 using HTML form and display the Prime Numbers between n and n2 using PHP.

	Total Hours	**30 Hours**
Text Books		
1	Ivan Bayross, "Web Enabled Commercial Applications Development Using HTML, JavaScript, DHTML and PHP", BPB Publications, 4th Revised Edition, 2010.	
Reference Books		
2	A.K. Saini and Sumint Tuli, "Mastering XML",First Edition, New Delhi, 2002.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/xml/index.htm	
2	https://www.tutorialspoint.com/internet_technologies/websites_development.htm	
3	https://www.youtube.com/watch?v=PlxWf493en4	

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		PRACTICAL : DATA MINING USING R	L	T	P	C
Core/Elective/Supportive		Core			4	2
Pre-requisite		Basics of DM Algorithms & R Programming				

Course Objectives :

The main objectives of this course are to:

1. To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, regression.
2. To understand & write programs using the DM algorithms.
3. To apply statistical interpretations for the solutions.
4. Able to use visualizations techniques for interpretations.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Able to write programs using R for Association rules, Clustering techniques	K1,K2
2	To implement data mining techniques like classification, prediction	K2,K3
3	Able to use different visualizations techniques using R	K4,K5
4	To apply different data mining algorithms to solve real world applications	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS	60 Hours

1. Implement Apriori algorithm to extract association rule of datamining.
2. Implement k-means clustering Technique.
3. Implement anyone Hierarchal Clustering.
4. Implement Classification algorithm.
5. Implement Decision Tree.
6. Linear Regression.
7. Data Visualization.

Total Hours	60 Hours

Text Books

1	Margaret H. Dunham, "Data Mining : Introductory and Advanced Topics", Pearson education,2003.
2	C.S.R. Prabhu, "Data Warehousing Concepts, Techniques, Products and Applications", PHI, Second Edition

Reference Books

1	Arun K. Pujari, "Data Mining Techniques", Universities Press (India)Pvt. Ltd.,2003.
2	Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining and OLAP",TMCH, 2001.

Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/data-warehouse
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		GUIDELINES FOR MOOC COURSE	L	T	P	C
Core/Elective/Supportive		Supportive				2

1. All the candidates who have enrolled for Post Graduate course in the affiliated colleges of Thiruvalluvar University must undergo one MOOC (Massive Open Online Course) course during the Second Semester of study, with a minimum of 2 credits, compulsorily.
2. The department shall assign a Faculty Member exclusively for handling MOOC Course, as the Advisor, for the Candidates during the Second Semester of the course.
3. The Advisor of the MOOC course is responsible for keeping track and / or monitoring of the various activities of the candidates pertaining to the MOOC Course from Registration of the Course till the credits earned by them are transferred to the University.
4. The Advisor shall inform the candidates, in advance, about the Notification of the Courses, that are FREE OF COST to the candidates by visiting the portals of MOOC Courses.
5. The department shall suggest one or more notified courses (before the Second Semester) that are relevant to the Programme that suits with a minimum of 2 Credits, for the Candidates to proceed during the Second Semester.
6. The candidates then select a course from the list of courses suggested by the Department.
7. The Advisor is responsible for assisting the Candidates for Registration, Information about the Schedule of the Course, Information about the Periodical Assessments, Making Candidates to Respond to the Assessments and assists the Candidates for Registering for the Certification, Directing to Pay required Fee for the Certification, Preparing the Candidates for the Certification Examination, etc.,
8. The Department shall take necessary efforts to convey the Results / Certification of the Successful Candidate's to the University through the Institution along with a copy of the Certificate issued to the Candidates and ensure that the Candidate's Credits earned through the MOOC Course are transferred to the University.
9. In case of the Unsuccessful Candidates in the Certification, the Advisor helps them to re-register for the same.
10. Visit https://swayam.gov.in for the complete details of MOOC Courses.

III SEMESTER

Course code		DIGITAL IMAGE PROCESSING	L	T	P	C
Core/Elective/Supportive		Core	6			5
Pre-requisite		Basics of Image Processing				

Course Objectives :

The main objectives of this course are to :

1. Learn basic image processing techniques for solving real problems.
2. Gain knowledge in image transformation and Image enhancement techniques.
3. Learn Image compression and Segmentation procedures.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the fundamentals of Digital Image Processing.	K1,K2
2	Understand the mathematical foundations for digital image representation, image acquisition, image transformation, and image enhancement.	K2,K3
3	Apply, Design, and Implement and get solutions for digital image processing problems.	K3,K4
4	Apply the concepts of filtering and segmentation for digital image retrieval.	K4,K5
5	Explore the concepts of Multi-resolution process and recognize the objects in an efficient manner	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	17 Hours

Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations.

Unit:2	IMAGE ENHANCEMENT	17 Hours

Image Enhancement in the spatial domain:- Background – some basic Gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods.

Unit:3	IMAGE RESTORATION	17 Hours
Image Restoration: A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations.		
Unit:4	**IMAGE COMPRESSION**	**17 Hours**
Image Compression : Fundamentals–Image compression models–Elements of Information Theory – Error Free compression – Lossy compression – Image compression standards.		
Unit:5	**IMAGE SEGMENTATION**	**17 Hours**
Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation.		
Unit:6	**Contemporary Issues**	**5 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**90 Hours**

Text Books	
1	Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Second Edition, PHI/Pearson Education.
2	B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2003.
Reference Books	
1	Nick Efford, "Digital Image Processing a practical introducing using Java", Pearson Education, 2004.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/105/117105135/
2	https://www.tutorialspoint.com/dip/index.htm
3	https://www.javatpoint.com/digital-image-processing-tutorial

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	M	S	M	M	S
CO2	S	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

III SEMESTER

Course code		CLOUD COMPUTING	L	T	P	C
Core/Elective/Supportive		Core	5			5
Pre-requisite		Basics of Cloud & its Applications				

Course Objectives :

The main objectives of this course are to :

1. Gain knowledge on cloud computing, cloud services, architectures, and applications.
2. Enable the students to learn the basics of cloud computing with real time usage.
3. How to store and share, in and from cloud.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the concepts of Cloud and its services	K1,K2
2	Collaborate Cloud for Event & Project Management	K3,K4
3	Analyze on cloud in –Word Processing, Spread Sheets, Mail, Calendar, Database	K4,K5
4	Analyze cloud in social networks	K5,K6
5	Explore cloud storage and sharing	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	14 Hours

INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.

Unit:2	CLOUD COMPUTING	14 Hours

CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloud computing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.

Unit:3	CLOUD SERVICES	14 Hours

USING CLOUD SERVICES Collaborating on calendars, Schedules, and task management, exploring online scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.

Unit:4	**OUTSIDE THE CLOUD**	**14 Hours**
OUTSIDE THE CLOUD Evaluating webmail services, Evaluating instant messaging, Evaluating web conference tools, creating groups on social networks, Evaluating online groupware, collaborating via blogs and wikis.		
Unit:5	**STORING AND SHARING**	**14 Hours**
STORING AND SHARING Understanding cloud storage, evaluating online file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.		
Unit:6	**Contemporary Issues**	**5 Hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**75 Hours**

Text Books

1	Michael Miller, "Cloud Computing", Pearson Education, New Delhi, 2009.

Reference Books

1	Anthony T. Velte, "Cloud Computing: A Practical Approach", 1st Edition, Tata McGraw Hill Education Private Limited, 2009.

Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	S	M	S	M	S	M	M	M	S
CO2	M	S	M	S	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

III – SEMESTER

Course code		NETWORK SECURITY AND CRYPTOGRAPHY	L	T	P	C
Core/Elective/Supportive		Core	5			5
Pre-requisite		Basics of Networks & its Security				

Course Objectives:

The main objectives of this course are to:

1. Enable students to learn Introduction to Cryptography, Web Security and Case studies in Cryptography.
2. To gain knowledge on classical encryption techniques and concepts of modular arithmetic and number theory.
3. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
4. To explore the design issues and working principles of various authentication Applications and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.

Expected Course Outcomes:

On the successful completion of the course, student will be able to :

1	Understand the process of the cryptographic algorithms	K1,K2
2	Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication	K2,K3
3	Apply and analyze appropriate security techniques to solve network security problem	K3,K4
4	Explore suitable cryptographic algorithms	K4,K5
5	Analyze different digital signature algorithms to achieve authentication and design secure applications	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	14 Hours

Introduction to Cryptography – Security Attacks – Security Services –Security Algorithm- Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5.

Unit:2	CRYPTOSYSTEM	14 Hours

Public-key Cryptosystem : Introduction to Number Theory-RSA Algorithm–Key Management -Diffie-Hellman Key exchange–Elliptic Curve Cryptography Message Authentication and Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.

Unit:3	**NETWORK SECURITY**	**14 Hours**
Network Security Practice : Authentication Applications–Kerberos–X.509Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.		
Unit:4	**WEB SECURITY**	**14 Hours**
WebSecurity-SecureSocketLayer–SecureElectronicTransaction.SystemSecurity-Intruders and Viruses – Firewalls– Password Security.		
Unit:5	**CASE STUDY**	**14 Hours**
Case Study : Implementation of Cryptographic Algorithms–RSA–DSA–ECC (C/JAVA Programming). Network Forensic – Security Audit - Other Security Mechanism: Introduction to: Stenography – Quantum Cryptography – Water Marking - DNA Cryptography		
Unit:6	**Contemporary Issues**	**5 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**75 hours**

Text Books	
1	William Stallings, “Cryptography and Network Security”, PHI/Pearson Education.
2	Bruce Schneir, “Applied Cryptography”, CRC Press.
Reference Books	
1	A. Menezes, P Van Oorschot and S. Vanstone, “Handbook of Applied Cryptography”, CRC Press, 1997
2	Ankit Fadia,” Network Security”, MacMillan.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105031/
2	http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html
3	https://www.tutorialspoint.com/cryptography/index.htm

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	L	S	M	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

III – SEMESTER

Course code		DATA SCIENCE AND ANALYTICS	L	T	P	C
Core/Elective/Supportive		Core	6			4
Pre-requisite		Basics of Data Science & its Applications				

Course Objectives :

The main objectives of this course are to :

1. Introduce the students to data science, bigdata & its ecosystem.
2. Learn data analytics &its life cycle.
3. To explore the programming language R, with respect to the data mining algorithms.
4. Relate the relationship between artificial intelligence, machine learning and data science.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand the concept of data science and its techniques	K1,K2
2	Review data analytics	K2,K3
3	Apply and determine appropriate Data Mining techniques using R to real time applications	K3,K4
4	Analyze on clustering algorithms	K4,K5
5	Analyze on regression methods in AI	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5 -Evaluate; K6-Create

Unit:1	INTRODUCTION	17 Hours

Introduction of Data Science : data science and bigdata–facets of data-data science process - Ecosystem- The Data Science process – six steps- Machine Learning.

Unit:2	BASICS OF DATA ANALYTICS	17 Hours

Data Analytics life cycle-review of data analytics-Advanced data Analytics-technology and tools.

Unit:3	DATA ANALYTICS USING R	17 Hours

Basic Data Analytics using R : R Graphical User Interfaces – Data Import and Export – Attribute and Data Types –Descriptive Statistics – Exploratory Data Analysis – Visualization Before Analysis – Dirty Data – Visualizing a Single Variable – Examining Multiple Variables – Data Exploration Versus Presentation.

Unit:4	CLUSTERING	17 Hours
Overview of Clustering : K-means – Use Cases – Overview of the Method – Perform a K-means Analysis using R –Classification – Decision Trees – Overview of a Decision Tree – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Tree in R – Bayes' Theorem – Naïve Bayes Classifier – Smoothing – Naïve Bayes in R.		

Unit:5	ARTIFICIAL INTELLIGENCE	17 Hours
Artificial intelligence : Machine Learning and deep learning in data science-Clustering, association rules. Linear regression-logistic regression-Additional regression methods.		

Unit:6	Contemporary Issues	5 hours
Expert lectures, online seminars – webinars		

	Total Lecture Hours	90 Hours

	Text Books
1	Introducing-Data-Science-Big-Data-Machine-Learning-and-more-using-Python-tools-2016.pdf
2	Data science in big data analytics-Wiley 2015 John Wiley & Sons
	Reference Books
1	A simple introduction to Data Science-Lars Nielson 2015
2	Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication
3	R Programming for Data Science-Roger D. Peng 2015 Lean Publication
4	Data Science & Big Data Analytics : Discovering, Analyzing, Visualizing and Presenting Data
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://www.tutorialspoint.com/python_data_science/index.htm
2	https://www.javatpoint.com/data-science
3	https://nptel.ac.in/courses/106/106/106106179/

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

III – SEMESTER

Course code		PRACTICAL : DIGITAL IMAGE PROCESSING USING MATLAB	L	T	P	C
Core/Elective/Supportive		Elective			4	3
Pre-requisite		Basic Programming of Image Processing & an introduction to MATLAB				

Course Objectives:

The main objectives of this course are to :

1. To understand the basics of Digital Image Processing fundamentals, image enhancement and image restoration techniques.
2. To enable the students to learn the fundamentals of image compression and segmentation.
3. To understand Image Restoration & Filtering Techniques.
4. Implementation of the above using MATLAB.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	To write programs in MATLAB for image processing using the techniques.	K1,K2
2	To able to implement Image Enhancements & Restoration techniques.	K2,K3
3	Capable of using Compression techniques in an Image.	K3,K4
4	Must be able to manipulate the image and Segment it.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS	**60 Hours**

1. Implement Image Enhancing Technique.
2. Histogram Equalization.
3. Image Restoration.
4. Implement Image Filtering.
5. Edge detection using Operators (Roberts, Prewitts and Sobels operators).
6. Implement image compression.
7. Image Subtraction.
8. Boundary Extraction using morphology.
9. Image Segmentation.

Total Hours	**60 Hours**

Text Books	
1	Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Second Edition, PHI/Pearson Education.
2	B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2003.
Reference Books	
1	Nick Efford, "Digital Image Processing A Practical Introducing Using Java", Pearson Education, 2004.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/105/117105135/
2	https://www.tutorialspoint.com/dip/index.htm
3	https://www.javatpoint.com/digital-image-processing-tutorial

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

III – SEMESTER

Course code		PRACTICAL : NETWORK SECURITY AND CRYPTOGRAPHY LAB	L	T	P	C
Core/Elective/Supportive		Elective			4	3
Pre-requisite		Basic Knowledge about Network Security				

Course Objectives:

- To develop in classical encryption techniques and advanced encryption standards.
- To acquire programming skills in Implement various cryptographic algorithms including secret key cryptography.
- To develop hashes, message digests and public key algorithms.
- Implement different encryption and decryption techniques.
- To comprehend related to confidentiality and authentication techniques.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Comprehend the programming skills in classical encryption techniques and to develop advanced encryption standards	K1-K6
2	Understand and implement the various cryptographic algorithms including secret key cryptography, hashes, and message digests	K1-K6
3	Evaluate the use of different encryption and decryption techniques	K1-K6
4	Design to Solve related confidentiality and authentication problems	K1-K6
5	Create public key algorithms	K1-K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS — **60 Hours**

1. Write a program that contains a string (char pointer) with a value 'Hello world'.

   The program should XOR each character in the string with 0 and display the result.
2. Write a program to perform encryption and decryption using the Ceaser Cipher.
3. Write a program to perform encryption and decryption using the Hill Cipher.
4. Write a program to perform encryption and decryption using the Substitution Cipher.
5. Write a program to perform encryption and decryption using the DES algorithm.
6. Connect to switch with a computer and enable the port security.
7. Defeating malware using Building Trojans and Rootkit hunter.
8. Implement signature scheme – Digital Signature Standard.
9. Identify and capture the username and password in a same network using wire shark.

10. Implement Man-in-the-middle attack and Session hijacking.	
Total Hours	**60 Hours**

Text Books	
1	William Stallings, "Cryptography and Network Security", PHI/Pearson Education.
2	Bruce Schneir, "Applied Cryptography", CRC Press.

Reference Books	
1	A. Menezes, P Van Oorschot and S. Vanstone, "Handbook of Applied Cryptography", CRC Press, 1997
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105031/
2	http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html
3	https://www.tutorialspoint.com/cryptography/index.htm

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	-	-	-	-	L	-	-	-	-
CO2	S	-	M	-	M	L	-	-	-	-
CO3	S	-	S	-	S	L	-	-	-	S
CO4	S	-	S	-	S	L	-	-	-	S
CO5	S	-	S	-	S	L	-	-	-	S

*S-Strong; M-Medium; L-Low

III – SEMESTER

Course code		PRACTICAL : CLOUD COMPUTING LAB	L	T	P	C
Core/Elective/Supportive		Core			4	2
Pre-requisite		Basic Programming using Cloud				

Course Objectives :

The main objectives of this course are to :

1. Deploy applications over commercial cloud computing infrastructures.
2. Experiment the Cloud and Virtualization Experience.
3. Understand the Cloud Storage and Security.
4. Implement the Cloud Environments with the available resources.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Articulate the main concepts, key technologies, strengths, and limitations of Cloud Computing and deploy applications over commercial cloud computing infrastructures.	K1,K2
2	Gain knowledge about cloud and virtualization along with it, how one can migrate over it.	K3,K4
3	Develop the ability to manage the cloud environment and understand the concepts of cloud storage, security.	K4,K5
4	Choose the appropriate technologies, algorithms, and approaches for implementation of cloud environment using Openstack / AWS / Microsoft Azure / Google App Engine, etc.,	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS	**60 Hours**

1. Working with Google Drive to make spread sheets and notes.
2. Launch a Linux Virtual Machine.
3. To host a static website
4. Exploring Google cloud for the following
   a). Storage b). Sharing of data c). Manage your calendar, to-do lists,
   d). a document editing tool.
5. Working and installation of Google App Engine.
6. Working and installation of Microsoft Azure.
7. To Connect Amazon Redshift with S3bucket.
8. To Create and Query a NoSQL Table.

Total Hours	**60 Hours**

Text Books	
1	Michael Miller, "Cloud Computing", Pearson Education, New Delhi, 2009.
Reference Books	
1	Anthony T. Velte, "Cloud Computing: A Practical Approach", 1st Edition, Tata McGraw Hill Education Private Limited, 2009.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

III – SEMESTER

Course code		INTERNSHIP	L	T	P	C
Core/Elective/Supportive		Core				2
Pre-requisite		Knowledge of Industrial Work Culture and Etiquette				

Course Objectives :

The main objectives of this course are to :

4. Introduce the Working Ambience, Attitude, Adaptability, Problem Solving Ability, Ability to work with Supervisor, Ability to take Directions, etc.,
5. Expose on the different phases of Developing a Computer Solution with Team Spirit.
6. Learn about Problem Solving Skills, Soft Skills and other related Skills required for the Industry.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Find the specific areas of interest, refine their skills and abilities	K1
2	Show a greater sense of self-awareness and appreciation for others	K2
3	Develop work habits and attitudes that are essential to succeed in the workplace	K3
4	Discover the importance of communication, interpersonal and other critical skills	K4
5	Choose and prioritize employment contacts leading directly to a full-time job immediately after the graduation from the college.	K5 & K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

REGULATIONS

1. The Candidates have to undergo a Minimum of 40 Hours of Internship Programme in the Industry during the holidays of the Second Semester of the Course of Study.
2. The Candidates need to get a Project, Analyze, learn the various stages of Developing a solution, Test, Validate and carryout the other related requirements.
3. During the course of Third Semester, the Candidates need to refine the work carried out during the Internship at the Industry, progress towards developing a better Solution as per the standards of the Industry and by carrying out the constructive comments received from the Industry and / or Institution during the Reviews.
4. Then the Candidates have to prepare and submit the manuscript of the Internship experience as a Report as per the requirements of the Institution / Department for Evaluation.
5. The submission of the Internship Report will be done at the end of the Third Semester for Presentation and Viva-Voce during the Practical Examinations of the Semester.

6. The Passing Minimum for Internship is 50%.
7. If the Candidate fails to score 50% in the Internship, the Candidate has to improve it during the next attempt.
8. A Faculty Member from the Department will act as a Guide to Supervise and Monitor the progress of the Candidates during the course of Internship.
9. The Faculty Member will act as the Internal Examiner during the course of Internship as well as at the time of conducting the Viva-Voce Examination.
10. The Internal Marks for the Internship will be awarded by the concerned Guide / Internal Examiner.
11. The Internal and External Examiners shall both evaluate the Internship Report, Presentation and conduct the Viva-Voce Examination.

INTERNAL MARKS AWARDED FOR THE INTERNSHIP – 40 Marks

1. Learning the Work Culture leading towards Performance, Organizations Skills and Relationship with Team Members – **10 Marks**
2. Internship Review 1 (During the beginning of the Semester) – **10 Marks**
3. Internship Review 2 (During the end of the Semester) – **10 Marks**
4. Progress of the Internship by the Candidate's active Participation – **10 Marks**

EXTERNAL MARKS AWARDED FOR THE INTERNSHIP – 60 Marks

1. Evaluation of the Internship Report - **20 Marks**
2. Presentation – **20 Marks**
3. Viva-Voce Examination – **20 Marks**

Total – 100 Marks

IV – SEMESTER

Course code		INTERNET OF THINGS	L	T	P	C
Core/Elective/Supportive		Core	6			5
Pre-requisite		Basics of Sensors & its Applications				

Course Objectives :

The main objectives of this course are to :

1. About Internet of Things where various communicating entities are controlled and managed for decision making in the application domain.
2. Enable students to learn the Architecture of IoT and IoT Technologies.
3. Developing IoT applications and Security in IoT, Basic Electronics for IoT, Arduino IDE, Sensors and Actuators Programming NODEMCU using Arduino IDE.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Understand about IoT, its Architecture and its Applications.	K1,K2
2	Understand basic electronics used in IoT & its role.	K2,K3
3	Develop applications with C using Arduino IDE.	K4
4	Analyze about sensors and actuators.	K5,K6
5	Design IoT in real time applications using today's internet &wireless technologies	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	17 Hours

Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT– Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT.

Unit:2	BASIC ELECTRONICS FOR IoT	17 Hours

Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – Binary Calculations – Logic Chips – Microcontrollers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation.

Unit:3	PROGRAMMING USING ARDUINO	17 Hours

Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions.

Unit:4	**SENSORS AND ACTUATORS**	**17 Hours**
Sensors and Actuators : Analog and Digital Sensors–Interfacing temperature sensor, ultrasound Sensor and infrared (IR) sensor with Arduino – Interfacing LED and Buzzer with Arduino.		
Unit:5	**SENSOR DATA ININTERNET**	**17 Hours**
Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU Wi-Fi Module – Programming NODEMCU using Arduino IDE – Using Wi-Fi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (Thing Speak).		
Unit:6	**Contemporary Issues**	**5 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**90 Hours**

Text Books

1	Arshdeep Bahga, Vijay Madisetti, "Internet of Things : A Hands-On Approach", 2014. ISBN: 978-0996025515
2	Boris Adryan, Dominik Obermaier, Paul Fremantle, "The Technical Foundations of IoT", Artech Houser Publishers, 2017.

Reference Books

1	Michael Margolis, "Arduino Cookbook", O"Reilly, 2011
2	Marco Schwartz, "Internet of Things with ESP8266", Packt Publishing, 2016.
3	Dhivya Bala, "ESP8266 : Step by Step Tutorial for ESP8266 IoT, Arduino NODEMCU Dev. Kit", 2018.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2	https://www.javatpoint.com/iot-internet-of-things
3	https://www.tutorialspoint.com/internet_of_things/index.htm

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	S	M	M	S	M
CO2	M	S	M	S	M	S	M	S	S	S
CO3	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

IV – SEMESTER

Course code		BLOCK CHAIN TECHNOLOGY	L	T	P	C
Core/Elective/Supportive		Core	6			5
Pre-requisite		Basics of Block Chain & Crypto Currency				

Course Objectives :

The main objectives of this course are to :

1. Understand the fundamentals of block chain and cryptocurrency.
2. Understand the influence and role of Block Chain in various other fields.
3. Learn security features and its significance.
4. Identify problems & challenges posed by Block Chain.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Demonstrate blockchain technology and crypto currency.	K1,K2
2	Understand the mining mechanism in blockchain.	K2
3	Apply and identify security measures, and various types of services that allow people to trade and transact with bitcoins.	K3,K4
4	Apply and analyze Blockchain in health care industry	K4,K5
5	Analyze security, privacy, and efficiency of a given Blockchain system	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit:1	INTRODUCTION	17 Hours

Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major application: currency, identity, chain of custody.

Unit:2	NETWORK AND SECURITY	17 Hours

Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain.

Unit:3	CRYPTOCURRENCY	17 Hours

Cryptocurrency - History, Distributed Ledger, Bitcoin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain

Unit:4	CRYPTOCURRENCY REGULATION	17 Hours
Crypto currency Regulation-Stakeholders, Roots of Bitcoin, Legal views-exchange of cryptocurrency - Black Market - Global Economy. Cyrpto economics–assets, supply and demand, inflation, and deflation – Regulation.		

Unit:5	CHALLENGES IN BLOCKCHAIN	17 Hours
Opportunities and challenges in Block Chain – Application of block chain: Industry 4.0 – machine to machine communication – Data management in industry4.0 – future prospects. Block chain in Health 4.0 - Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using blockchain for healthcare data		

Unit:6	Contemporary Issues	5 hours
Expert lectures, online seminars – webinars		

	Total Lecture Hours	90 Hours

	Text Books
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press (July 19, 2016).
2	Antonopoulos, "Mastering Bitcoin : Unlocking Digital Cryptocurrencies"
	Reference Books
1	Satoshi Nakamoto, "Bitcoin : A Peer-to-Peer Electronic Cash System"
2	Rodrigoda Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh, "Blockchain Technology for Industry 4.0" Springer 2020.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://www.javatpoint.com/blockchain-tutorial
2	https://www.tutorialspoint.com/blockchain/index.htm
3	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

IV – SEMESTER

Course code		PROJECT WORK AND VIVA-VOCE	L	T	P	C
Core/Elective/Supportive		Core			10	7
Pre-requisite		Knowledge of Software Development Phases				

Course Objectives :

The main objectives of this course are to :

1. Expose to the various phases of Software Development Life Cycle.
2. Learn to apply the Skills and Knowledge in Design, Coding and Testing with appropriate Technological Tools and Procedures.
3. Learn to Develop Applications with Personal, Societal and Professional Ethical Standards.

Expected Course Outcomes :

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

1	Show Leadership Skills and Learn Time Management	K1
2	Identify various Tools to be applied to a specific Problem	K2
3	Evaluate the Reports	K3
4	Involve in the Team and Manage it to deliver the excellent Outcomes	K4
5	Assess and Develop the Individual Skills to Present and Organize the Projects	K5 & K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

REGULATIONS

1. The Candidates have to undergo a Minimum of 150 Hours of Project Work during the Course of Study either in an IT Industry / Public or Private Sector Organization / Research Institutes / Institution itself.
2. The Candidates need to identify and analyze real world problems on the selected project domain.
3. During the course of study, the Candidates need to Develop, Design, Test, etc., the Applications as per the directions by the Guide.
4. Then the Candidates have to prepare and submit the manuscript of the Project Work as a Report as per the requirements of the Institution / Department for Evaluation.
5. The submission of the Project Report will be done at the end of the Semester for Presentation and Viva-Voce during the Practical Examinations of the Semester.

6. The Passing Minimum for Project Work is 50%.
7. If the Candidate fails to score 50% in the Project Work, the Candidate has to improve it during the next attempt.
8. A Faculty Member from the Department will act as a Guide to Supervise and Monitor the progress of the Candidates during the course of Project Work.
9. The Faculty Member will act as the Internal Examiner during the course of Project Work as well as at the time of conducting the Viva-Voce Examination.
10. The Internal Marks for the Project Work will be awarded by the concerned Guide / Internal Examiner.
11. The Internal and External Examiners shall both evaluate the Project Report, Presentation and conduct the Viva-Voce Examination.

INTERNAL MARKS AWARDED FOR THE PROJECT WORK – 80 Marks

1. Plan of the Project – **15 Marks**
2. Execution of the Plan – **15 Marks**
3. Individual Initiative – 1**0 Marks**
4. Review 1 – **20 Marks**
5. Review 2 – **20 Marks**

EXTERNAL MARKS AWARDED FOR THE PROJECT WORK – 120 Marks

1. Evaluation of the Project Report - **50 Marks**
2. Presentation – **30 Marks**
3. Viva-Voce Examination – **40 Marks**

Total – 200 Marks

IV – SEMESTER

Course code		PRACTICAL : INTERNET OF THINGS LAB	L	T	P	C
Core/Elective/Supportive		Elective			4	3
Pre-requisite		Basics of Sensors & its Applications				

Course Objectives:

1. To create IoT program to turn ON/OFF LED.
2. To implement IoT program for object detection.
3. To develop IoT programs for agricultural purposes.
4. To create web server program for local hosting.
5. To design IoT application for health monitoring.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Implement IoT programs to turn ON/OFF LED.	K1 – K6
2	Develop IoT programs for object detection.	K1 – K6
3	Create IoT programs for agricultural purpose.	K1 – K6
4	Implement web server program for local hosting.	K1 – K6
5	Design various IoT applications.	K1 – K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS — **60 Hours**

1. To develop an IoT program to turn ON/OFF LED light (3.3V)
2. To develop an IoT program using IR sensor (Smart Garbage Monitoring, Detecting Parking Availability, etc.)
3. To develop an IoT program using Humidity and Temperature Monitoring (Forest fire Detection, Weather Monitoring)
4. To develop an IoT web server program for local hosting
5. To develop an IoT program using Soil Moisture Sensor
6. To develop an IoT program using Ultrasonic Sensor (Distance Measurement, etc.)
7. To develop a real-time IoT program using Relay Module (Smart Home Automation with 230V)
8. To develop an IoT program for Fire Detection (Home, Industry, etc.)
9. To develop an IoT program for Gas Leakage detection (Home, Industry, etc.)

10. To develop an IoMT program using Heartbeat Sensor	
Total Hours	**60 Hours**

Text Books

1	Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014.
2	Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black", McGraw Hill, 2015.

Reference Books

1	Ovidiu Vermesan and Peter Friess, "Internet of Things – From Research and Innovation to Market Deployment", River Publishers, 2014.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
2	https://www.shiksha.com/online-courses/industrial-internet-of-things-iiot-course-cour1405
3	https://ibm.com/topics/internet-of-things

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	M	S	S	S	S	M	S	S	M
CO4	S	S	S	S	S	S	S	S	S	L
CO5	S	S	S	S	M	S	L	S	S	M

*S-Strong; M-Medium; L-Low

IV – SEMESTER

Course code		PRACTICAL : BLOCK CHAIN TECHNOLOGIES LAB	L	T	P	C
Core/Elective/Supportive		Elective			4	3
Pre-requisite		Basics of Block Chain & Crypto Currency				

Course Objectives:

1. To learn the basics of Blockchain and apply cryptographic algorithms.
2. To design, build, and deploy smart contracts and distributed applications.
3. To deploy Private Blockchain and smart contracts on Ethereum.
4. To understand and deploy cryptocurrencies and their functions in applications.
5. To implement Blockchain for various use cases.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Enable to setup your own private Blockchain and deploy smart contracts on Ethereum.	K1 – K6
2	Gains familiarity and implement with cryptography and Consensus algorithms.	K1 – K6
3	Create and deploy projects using Web3j.	K1 – K6
4	Recall and deploy the structure & mechanism of Bitcoin, Ethereum, Hyperledger	K1 – K6
5	Implement Blockchain for various use cases	K1 – K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS	60 Hours

1. Create a Public Ledger and Private Ledger with various attributes like Access, Network Actors, Native token, Security, Speed and examples.
2. Building and Deploying Multichain private Blockchain.
3. Write Hello World smart contract in a higher programming language (Solidity).
4. Construct the Naïve block chain.
5. Construct and deploy your contract (Use deploy method).
6. Set up a Regtest environment.
7. Build a payment request URI.
8. Hash Cash implementation.
9. Develop a toy application using Blockchain.
10. Create simple wallet transaction from one account to another account using MetaMask.

Total Hours	60 Hours

Text Books	
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder. Bitcoin and Cryptocurrency Technologies. Princeton University Press, 2016. ISBN 978-0691171692.

Reference Books	
1	Andreas Antonopoulos. Mastering Bitcoin: Programming the open block chain. Oreilly Publishers, 2017. ISBN 978-9352135745

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.techtarget.com/searchcio/feature/Todays-blockchain-use-cases-and-industry-applications
2	https://www.shiksha.com/online-courses/basics-of-blockchain-course-grlel877

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	L	M	S	M	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	M	S	S	M
CO4	S	M	L	S	M	S	S	S	S	L
CO5	M	S	M	L	S	S	L	S	S	M

*S-Strong; M-Medium; L-Low

IV – SEMESTER

Course code		PRACTICAL : SOFT SKILL DEVELOPMENT LAB	L	T	P	C
Core/Elective/Supportive		Supportive			4	2
Pre-requisite		Basics of Soft Skills				

Course Objectives:

1. To enable students to gain basic communication skills in professional and social contexts effectively.
2. To acquire useful words and apply them in situational context.
3. To develop listening and reading skills through comprehension passages.
4. To enrich leadership qualities and interpersonal communication.
5. To enhance essential characteristics in writing.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Gain basic communication skills in professional and social contexts effectively.	K1 – K6
2	Acquire useful words and apply them in situational context.	K1 – K6
3	Develop listening and reading skills through comprehension passages.	K1 – K6
4	Enrich leadership qualities and interpersonal communication.	K1 – K6
5	Enhance essential characteristics in writing.	K1 – K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF EXERCISES — **60 Hours**

1. Characteristics of Technical Writing.
2. Development of Employability Skills.
3. Vocabulary Development.
4. Sentence Completion.
5. Error Spotting.
6. Interpretation of Verbal Analogy.
7. Interpretation of Reading (Comprehension - Conception).
8. Interpretation of Reading (Comprehension - Reasoning).
9. Practice for writing E-mails/Technical Blogs/Forums.
10. PPT Preparation / Demonstration of Technical Presentation.
11. Preparation of Resume.
12. Preparation for Job Interviews / Mock Interview Section.
13. Group Discussion Skills.

14. Developing Listening Skill (Comprehension). 15. Practice for Short Speeches / Situational Conversation. 16. English through Mass Media. 17. Essential Grammar. 18. Communicating and collaborating with peer members. 19. Team Empowerment. 20. Persuasive Communication.	
Total Hours	**60 Hours**
Text Books	
1	Uma Narula, "Development Communication: Theory and Practice", Revised Edition, Har-Aanad Publication, 2019.
2	Annette Capel and Wendy Sharp, "Cambridge English: Objective First", Fourth Edition, Cambridge University Press, 2013.
3	Emma Sue-Prince, "The Advantage: The 7 Soft Skills You Need to Stay One Step Ahead", First Edition, FT Press, 2013.
4	Guy Brook-Hart, "Cambridge English: Business Benchmark", Second Edition, Cambridge University Press, 2014.
5	Norman Lewis, "How to Read Better & Faster", Binny Publishing House, New Delhi, 1978.
Reference Books	
1	Michael McCarthy and Felicity O'Dell, "English Vocabulary in Use:100 Units of Vocabulary Reference and Practice", Cambridge University Press,1996.
2	Murphy, Raymond, "Intermediate English Grammar", Second Edition, Cambridge University Press, 1999.

IV – SEMESTER

Course code		PRACTICAL : DATA VISUALIZATION LAB	L	T	P	C
Core/Elective/Supportive		Supportive			4	2
Pre-requisite		Basics Of Visualization Tools				

Course Objectives:

1. To learn the basic functions and operations of Excel and tableau.
2. To explore to design, build, and deploy various charts for applications.
3. To comprehend, design and deploy the label and heat map.
4. To understand and deploy dashboard.
5. To understand the functions of tableau for data process.

Expected Course Outcomes :

On the successful completion of the course, student will be able to :

1	Enable to create and apply Spread sheet and Tableau for various data processing	K1 – K6
2	Gains knowledge to create and design various visualization tools in Excel and Tableau.	K1 – K6
3	Comprehend, create, and deploy labels and heat map.	K1 – K6
4	Enable to create and apply dashboard for various data processing	K1 – K6
5	Illustrate and apply data visualization tool for any data set	K1 – K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

LIST OF PROGRAMS — **60 Hours**

Note: Use the following Dataset
http://www.tableau.com/sites/default/files/training/global_superstore.zip

IMPLEMENT THE FOLLOWING USING EXCEL

1. Create Pie chart for Sales and Sales % by Country (sorted in descending order).
2. Create Bar chart for Sales by Country by Year (rounded to nearest thousand and sorted by Grand Total).
3. Create Line char for Sales by Ship Mode (First Class, Same Day, Second Class and Standard Class).
4. Create Scatter chart for Sales by Ship Mode by Country (rounded to the nearest dollar and sorted by First Class).
5. Create heat map for Sales by Category by Sub-Category (in thousands and sorted by sales value in descending order).
6. Design and create the label for vendor list.
7. Design and create the dashboard.

IMPLEMENT THE FOLLOWING USING TABLEAU

1. Sales by Ship Mode (First Class, Same Day, Second Class, and Standard Class).
2. Sales by Ship Mode by Country (rounded to the nearest dollar and sorted by First Class).
3. Sales by Category by Sub-Category (in thousands and sorted by sales value in descending order).

Total Hours — **60 Hours**

Course code		GUIDELINES FOR EXTENSION ACTIVITY	L	T	P	C
Core/Elective/Supportive		Supportive				1

1. All the candidates who have enrolled for Post Graduate course in the affiliated colleges of Thiruvalluvar University must become a Member of any one the Extension Activities that is offered in the Institution / College, namely, National Service Scheme (NSS), Youth Red Cross (YRC), Red Ribbon Club (RRC), Eco Club, Rovers and Rangers, etc., that serves the people of the neighborhood through its various activities.
2. The department must facilitate the Candidates to register any one of the Extension Activity Club / Forum that are functioning in the Institution / College.
3. The Candidates are then expected to actively participate in the various activities organized by the above Clubs / Forum and complete the same within the Stipulated time.
4. The Club / Forum shall declare the Candidates successful at the end of the Semester / Year if they complete the activities and earn 1 credit or certificate from the Club / Forum.
5. The Department shall take necessary efforts to convey the Credit / Certification received from the Successful Candidates of the Club / Forum to the University through the Institution along with a copy of the Certificate issued to the Candidates and ensure that the Candidate's Credit is transferred to the University.
6. In case of the Unsuccessful Candidates in the Certification, the Candidates themselves have to re-register for the same.