M.Sc. COMPUTER SCIENCE

Proposed Course Structure based on UGC - LOCF and TANSCHE

(Choice Based Credit System)

(Applicable for the candidates admitted from the academic year 2023-2024 onwards)

Sem.	Course Code	Course Title	Hrs / Week	Credit	Exam Hrs	Marks		Total
						Int.	Ext.	
I	P1R3CSCC1	Analysis & Design of Algorithms	6	5	3	25	75	100
	P1R3CSCC2	Object Oriented Analysis and Design & C++	6	5	3	25	75	100
	P1R3CSCC3P	Algorithm and OOPs Lab	6	4	3	40	60	100
	P1R3CSDSE 1:1	Mobile Computing	6	3	3	25	75	100
	P1R3CSDSE 1:2	Pervasive Computing	4	3	3	25	75	100
	P1R3CSDSE 1:3	Theory of computing	4	3	3	25	75	100
	P1R3CSDSE 2:1	Internet of Things	4	3	3	25	75	100
	P1R3CSDSE 2:2	Virtual and Augmented Reality	4	3	3	25	75	100
	P1R3CSDSE 2:3	Embedded system	4	3	3	25	75	100
TOTAL			**30**	**20**				**500**
II	P2R3CSCC4	Data Mining and Warehousing	6	5	3	25	75	100
	P2R3CSCC5	Python Programming	6	5	3	25	75	100
	P2R3CSCC6P	Python Programming Lab	6	4	3	40	60	100
	P2R3CSDSE 3:1	Compiler Design	3	4	3	25	75	100
	P2R3CSDSE 3:2	Block Chain Technology	3	4	3	25	75	100
	P2R3CSDSE 3:3	Distributed Technologies	3	4	3	25	75	100
	P2R3CSDSE 4:1	Web Services	3	4	3	25	75	100
	P2R3CSDSE 4:2	Big Data Analytics	3	4	3	25	75	100
	P2R3CSDSE 4:3	Advanced Software Engineering	3	4	3	25	75	100
	P2R3CSSEC 1:1	Web programming	2	4		25	75	100
	P2R3CSSEC 1:2	React JS	2	4	3	25	75	100
	P2R3CSSEC 1:3	WAP andXML	2	4	3	25	75	100
TOTAL			**30**	**22**				**600**

Core Course I - ANALYSIS & DESIGN OF ALGORITHMS

Course Code: P1R3CSCC1	**Credit:** 5
Category: Core Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Skill Development	**Marks:** CIA: 25+ EXT: 75 = 100

COURSE OBJECTIVES

1. Enable the students to learn the Elementary Data Structures and algorithms.
2. Presents an introduction to the algorithms , their analysis and design.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Discuss various methods like Basic Traversal and Search Techniques, divide and conquer method, Dynamic programming, backtracking.
5. Understand the various design and analysis of the algorithms.

Unit-I: Introduction **HOURS: 18**

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-II: Traversal and Search Techniques **HOURS: 18**

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

Unit-III: Greedy Method **HOURS: 18**

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

Unit-IV: Dynamic Programming **HOURS: 18**

Dynamic Programming – General Method – Multi stage Graphs – All Pair Shortest Path – Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.

Unit-V: Back tracking **HOURS: 18**

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

Text books:

1. EllisHorowitz ,“Computer Algorithms”, Galgotia Publications.
2. Alfred V.Aho , JohnE.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,Websitesetc.]

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

COURSE OUTCOMES:

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

CO1	Demonstrate specific search and sort algorithms using divide and conquer technique.
CO2	Gain good understanding of Greedy method and its algorithm.
CO3	Able to describe about graphs using dynamic programming technique.
CO4	Demonstrate the concept of back tracking & branch and bound technique.
CO5	Explore the traversal and searching technique and apply it for trees and graphs.

Core Course II - OBJECT ORIENTED ANALYSIS AND DESIGN & C++

Course Code: P1R3CSCC2	**Credit:** 5
Category: Core Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Employability	**Marks:** CIA: 25+ EXT: 75 = 100

COURSE OBJECTIVES

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.
4. To learn how inheritance promote cod reuse in C++.
5. To learn how to use exception handling in C++.

Unit-I: Object Model . HOURS: 18

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-II: Classes and Objects HOURS: 18

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-III: C++ Introduction HOURS: 18

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

Unit-IV: Inheritance and Overloading HOURS: 18

Classes and Objects–Constructors and Destructors–operators overloading–Type Conversion- Inheritance – Pointers and Arrays..

Unit-V: Polymorphism and Files HOURS: 18

Memory Management Operators – Polymorphism – Virtual functions –Files – Exception Handling – String Handling -Templates.

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,Websitesetc.]

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

COURSE OUTCOMES:

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

CO1	Understand the concept of Object-Oriented development and modeling techniques
CO2	Gain knowledge about the various steps performed during object design
CO3	Abstract object – based views for generic software systems
CO4	Link OOAD with C++ language
CO5	Apply the basic concept of OOPs and familiarize to write C++ program

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Core Course III – ALGORITHM AND OOPS LAB

Course Code: P1R3CSCC3P	**Credit:** 4
Category: Core Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Employability	**Marks:** CIA: 40+ EXT: 60 = 100

COURSE OBJECTIVES:

1. This course covers the basic data structures like Stack, Queue, Tree,List.
2. This course enables the students to learn the applications of the data structures using various techniques.
3. Apply important algorithmic design paradigms and methods of analysis.
4. It also enables the students to understand C++ language with respect to OOAD concepts.
5. Application of OOPS concepts.

List of Programs

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 circular queue.
5) Write a program to sort an array of an 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 greedy method
8) Write a program to search for an element in a tree using divide & conquer strategy.
9) Write a program to placethe8 queens on an8X8matrixso 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.

COURSE OUTCOMES:

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

CO1	Understand the concepts of object oriented with respect to C++
CO2	Able to understand and implement OOPS concepts
CO3	Implementation of data structures like Stack, Queue, Tree, List using C++
CO4	Analyze the application of the data structures for Sorting, Searching using different techniques.
CO5	Illustrate and evaluate the file Input Output mechanism

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Elective Course – I

1. MOBILE COMPUTNG

Course Code: P1R3CSDSE1:1	**Credit:** 3
Category: Discipline Specific Elective Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Skill Development	**Marks:** CIA: 25+ EXT: 75 = 100

COURSE OBJECTIVES:

1. To know the evolution of Mobile Communication and ceel concept to improve capacity of the system.
2. Present the overview of Mobile computing, Applications and Architectures.
3. Describe the futuristic computing challenges.
4. Have knowledge on the emerging technologies wireless and mobile communications
5. Enable the students to learn the concept of mobile computing.

UNIT 1: Introduction **Hours : 18**

Introduction: Advantages of Digital Information - Introduction to Telephone Systems –Mobile communication: Need for Mobile Communication – Requirements of Mobile Communication – History of Mobile Communication.

UNIT 2: .Mobile Communication **Hours : 18**

Introduction to Cellular Mobile Communication – Mobile Communication Standards –Mobility Management – Frequency Management – Cordless Mobile Communication Systems.

UNIT 3: Mobile Computing **Hours : 18**

Mobile Computing: History of data networks – Classification of Mobile data networks - CDPD System – Satellites in Mobile Communication: Satellite classification – Global Satellite Communication – Changeover from one satellite to other – Global Mobile Communication – Interferences in Cellular Mobile Communication.

UNIT 4: Mobile Communication System **Hours : 18**

Important Parameters of Mobile Communication System – Mobile Internet: Working of Mobile IP – Wireless Network Security – Wireless Local Loop Architecture: Components in WLL – Problems in WLL – Modern Wireless Local Loop – Local Multipoint Distribution Service – Wireless Application Protocol.

UNIT 5: Communication Technology **Hours : 18**

WCDMA Technology and Fiber Optic Microcellular Mobile Communication – Ad hoc Network and Bluetooth technology – Intelligent Mobile Communication system – Fourth Generation Mobile Communication systems.

Text books:

1. T.G.Palanivelu, R.Nakkeeran"WirelessandMobileCommunication",PHILimited,2009.
2. Jochen Schiller,"Mobile Communications",Second Edition, Pearson Education, 2007.

Reference Books:

1. Asoke K Talukder,HasanAhmed,RoopaYavagal,"MobileComputing",TMH,2010.

Related Online Contents[MOOC,SWAYAM,NPTEL,Websitesetc.]

1. https://www.tutorialspoint.com/mobile_computing/index.htm
2. https://www.javatpoint.com/mobile-computing
3. https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/

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

COURSE OUTCOMES:

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

CO1	Understand the need and requirements of mobile communication.
CO2	Focus on mobile computing applications and techniques.
CO3	Demonstrate satellite communication in mobile computing.
CO4	Analyze about wireless local loop architecture.
CO5	Analyze various mobile communication technologies.

2. PERVASIVE COMPUTING

Course Code: P1R3CSDSE1:2	**Credit:** 3
Category: Discipline Specific Elective Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Skill Development	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES:

1. To familiarize students with various application scenarios of Pervasive Computing.
2. **To** create awareness about the architecture and functioning of Pervasive Systems.
3. To understand the enabling technologies of Pervasive Computing.
4. To create presentations using Pervasive Computing techniques and devices.
5. To identify critical technologies and acquire knowledge about connectivity and information access via pervasive devices.

Unit – I: Introduction to Pervasive Computing HOURS: 18

Pervasive Computing: Past, Present and Future Pervasive Computing-Pervasive Computing Market-m-Business-Application examples: Retail, Airline check-in and booking-Sales force automation-Health care-Tracking-Car information system-E-mail access via WAP

Unit – II: Device Technology HOURS: 18

Device Technology: Hardware-Human Machine Interfaces-Biometrics-Operating Systems-Java for Pervasive devices

Unit – III: Device Connectivity HOURS: 18

Device Connectivity: Protocols-Security-Device Management Web Application Concepts: WWW architecture-Protocols-Transcoding-Client authentication via internet

Unit – IV: WAP and Beyond HOURS: 18

WAP and Beyond: Components of the WAP architecture-WAP infrastructure WAP security issues-WML-WAP push-Products-i-Mode-Voice Technology: Basics of Speech recognition- Voice Standards-Speech applications-Speech and Pervasive Computing

Unit – V: PDA HOURS: 18

PDA: Device Categories-PDA operation Systems-Device Characteristics Software Components-Standards-Mobile Applications-PDA Browsers Pervasive Web Application architecture: Background-Scalability and availability Development of Pervasive Computing web applications-Pervasive application architecture.

Text Book:

1. Pervasive Computing, Technology and Architecture of Mobile Internet Applications, Jochen Burkhardt, Horst Henn, Stefan Hepper, Thomas Schaech & Klaus Rindtorff, Pearson Education, 2006

Reference Book:

1. Fundamentals of Mobile and Pervasive Computing, Frank Adelstein, Sandeep KS Gupta, Golden Richard III, Loren Schwiebert, McGraw Hill edition, 2006.

COURSE OUTCOMES:

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

CO1	Understand the fundamental theoretical concepts in concepts Pervasive Computing
CO2	Get clear idea about WAP architecture and security.
CO3	Gain knowledge for efficient resource allocation and task migration
CO4	Become familiar with voice standards
CO5	Identify user interface issues in Pervasive Computing

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3. THEORY OF COMPUTATION

Course Code: P1R3CSDSE1:3	**Credit:** 3
Category: Discipline Specific Elective Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Skill Development	**Marks:** CIA: 25+ EXT: 75 = 100

COURSE OBJECTIVES

- Introduce core concepts in Automata and Theory of Computation
- Identify different Formal language Classes and their Relationships.
- Design Grammars and Recognizers for different formal languages
- Prove or disprove theorems in automata theory using their properties.
- Determine the decidability and intractability of Computational problems.

UNIT- I: History of automata , DFA and NFA **HOURS: 18**

History of automata- grammar-Chomsky hierarchy-use of automata characteristics of automata-finite automata-graphical and tabular representation transactional system-DFA and NFA –conversion of NFA to DFA-Equivalence of DFA and NFA-Dead state-Finite automata with output-conversion of one machine to minimization of finite automata-Two way finite automata

UNIT- II:Finite state machine and regular expression **HOURS: 18**

Finite state machine-state equivalence and minimization of machine - incompletely specified machine-merger graph- merger table-finite memory and definite memory information lossless machine-inverse machine-minimal inverse machine-ardens theorem-construction of finite automata from regular expression

UNIT- III: Finite Automata, Lemma **HOURS: 18**

Equivalence of two finite automata- Equivalence of two regular expression- construction of regular grammar from an RE-constructing FA from regular grammar-Pumping lemma for regular expression--derivation and parse tree-Ambiguity in context free grammar-left recursion and left factoring-linear grammar-normal form – pumping lemma for CFL-Ogdens lemma for CFL

UNIT- IV: PDA, NPDA **HOURS: 18**

Push down automata-acceptance PDA-DPDA and NPDA-Construction of PDA from CFG-construction of CFG equivalent to PDA-Graphical notation for PDA-Turing Machine-transactional representation of turing machine –non deterministic turing – conversion of regular expression to turing machine.

UNIT- V: Turing Machine **HOURS: 18**

Variations of turing machine-turing machine as an integer function-Universal turing machine-linear bounded automata- undecidability- reducibility

TEXT BOOK:

1. ShyamlenduKandar, "Introduction to automata theory, formal languages and Computation" First Edition, Pearson Education, 2013.

REFERENCE BOOK:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2011.

COURSE OUTCOMES:

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

CO1	Gain knowledge of computing and mathematics appropriate to the discipline
CO2	Analyze and construct automata, regular expressions and grammars
CO3	Understand the concepts and methodology of automata.
CO4	Evaluate the push down automata and various Turing machines
CO5	Solve computational problems regarding their computability and complexity and prove the basic results of the theory of computation

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Elective Course II

1. Internet of Things

Course Code: P1R3CSDSE2:1	**Credit:** 3
Category: Discipline Specific Elective Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Skill Development	**Marks:** CIA: 25+ EXT: 75 = 100

COURSE OBJECTIVES

1. To know 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. Develop IoT applications and Security in IoT, Basic Electronics for IoT, Arduino IDE, Sensors and Actuators Programming NODEMCU using Arduino IDE.
4. Able to design & develop IoT devices.
5. Able to realize the revolution of Mobile devices, Cloud & Sensor networks.

UNIT-I: Introduction to IoT HOURS: 18

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-II: Basic Electronics for IoT HOURS: 18

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

UNIT-III: PROGRAMMING USING ARDUINO HOURS: 18

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-IV: SENSORS AND ACTUATORS HOURS: 18

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-V: SENSOR DATA IN INTERNET **HOURS: 18**

Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (ThingSpeak).

TEXT BOOKS

1. Arshdeep Bahga, VijayMadisetti, "Internet of Things – A hands-on approach", UniversitiesPress,2015.
2. Boris Adryan, Dominik Obermaier, Paul Fremantle, "The Technical Foundations of IoT", Artech Houser Publishers, 2017.

REFERENCE BOOKS

1. MichaelMargolis,"ArduinoCookbook",O"Reilly,2011Networks, Crowds and Markets: Reasoning About a Highly Connected World - David Easley and Jon Kleinberg, CambridgeUniversityPress-2010.
2. MarcoSchwartz, "InternetofThingswithESP8266",Packt Publishing, 2016.
3. DhivyaBala,"ESP8266:StepbyStepTutorialforESP8266IoT,ArduinoNODEMCU Dev. Kit", 2018.

WEB REFERENCES

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

COURSE OUTCOMES:

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

	COURSE OUTCOMES
CO1	Understand about IoT, its Architecture and its Applications
CO2	Understand basic electronics used in IoT &it srole
CO3	Develop applications with Cusing Arduino IDE
CO4	Analyze about sensors and actuators
CO5	Design IoT in real time applications using today's internet & wireless technologies

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2. VIRTUAL AND AUGMENTED REALITY

Course Code: P1R3CSDSE2:2	**Credit:** 3
Category: Discipline Specific Elective Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Skill Development	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

1. Enable users to explore and interact with a virtual surrounding in a way that approximates reality.
2. Students will be exposed to the process of creating virtual environments.
3. Develop IoT applications and Security in IoT, Basic Electronics for IoT, Arduino IDE, Sensors and Actuators Programming NODEMCU using Arduino IDE.
4. Able to design & develop IoT devices.
5. Able to realize the revolution of Mobile devices, Cloud & Sensor networks.

UNIT-I : Virtual Reality and Input Devices HOURS: 18

Virtual Reality: The Three I's of VR – History – Early commercial VR Technology – Components of a VR System –**Input Devices:** Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces

UNIT-II : Output Devices and VR Programming HOURS: 18

Output Devices: Graphics Displays – Sound Displays – Haptic Feedback - **Computer Architecture for VR:** The Rendering Pipeline- PC Graphics Architecture - **VR Programming:** Toolkits and Scene Graphs – Traditional and Emerging Applications of VR

UNIT-III : Augmented Reality and its Concepts HOURS: 18

Augmented Reality: Introduction – **Augmented Reality Concepts:** Working Principle of AR –Concepts related to AR- Ingredients of an Augmented Reality Experience

UNIT-IV : Augmented Reality Hardware HOURS: 18

Augmented Reality Hardware– Augmented Reality Software– Software to create content for AR Application – Tools and Technologies

UNIT-V: Augmented Reality Content HOURS: 18

Augmented Reality Content: Introduction- Creating Content for Visual, Audio, and other senses – Interaction in AR - **Mobile Augmented Reality:** Introduction – Augmented Reality Applications Areas- Collaborative Augmented Reality.

Text Books:

1. Grigore C. Burdea and Philippe Coiffet, "Virtual Reality Technology", Wiley Student Edition , Second Edition (Unit I: Chapter 1,2 & Unit II: Chapter 3,4,6,8 & 9)
2. Alan B. Craig(2013), "Understanding Augmented Reality: Concepts and Applications"(Unit III: Chapter 1, 2, Unit IV : Chapter 3, 4 & Unit V: Chapter 5,6,8)
3. Jon Peddie (2017), "Augmented Reality: Where We Will All Live", Springer, Ist Edition (Unit IV: Chapter 7 (Tools & Technologies)

Reference Books:

1. Alan Craig & William R. Sherman & Jeffrey D. Will, Morgan Kaufmann(2009), "Developing Virtual Reality Applications: Foundations of Effective Design", Elsevier(Morgan Kaufmann Publishers)
2. Paul Mealy (2018), "Virtual and Augmented Reality",Wiley
3. Bruno Arnaldi & Pascal Guitton & Guillaume Moreau(2018), "Virtual Reality and Augmented Reality: Myths and Realities", Wiley

Website and e-Learning Sources:

1. Manivannan, M., (2018), "Virtual Reality Engineering," IIT Madras, https://nptel.ac.in/courses/121106013
2. Dube, A., (2020), "Augmented Reality - Fundamentals and Development," NPTEL Special Lecture Series, https://www.youtube.com/watch?v=MGuSTAqlZ9Q
3. http://msl.cs.uiuc.edu/vr/
4. http://www.britannica.com/technology/virtual reality/Living-in -virtual-worlds
5. https://mobidev.biz/blog/augmented-reality-development-guide

COURSE OUTCOMES:

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

	Course Outcomes
CO1	Outline the basic terminologies, techniques and applications of VR and AR
CO2	Describe different architectures and principles of VR and AR systems
CO3	Use suitable hardware and software technologies for different varieties of virtual and augmented reality applications
CO4	Analyze and explain the behavior of VR and AR technology relates to human perception and cognition
CO5	Assess the importance of VR/AR content and interactions to implement for the real-world problem

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3. EMBEDDED SYSTEMS

Course Code: P1R3CSDSE2:3	**Credit:** 3
Category: Discipline Specific Elective Course	**Hrs/Week:** 6, **Total Inst.Hrs:** 90
Nature of the Course: Skill Development	**Marks:** CIA: 25+ EXT: 75 = 100

COURSE OBJECTIVES:

1. Present the introduction to 8051 Microcontroller Instruction Set, concepts on RTOS & Software tools.
2. Gain the knowledge about the embedded software development.
3. To impart knowledge in various processor scheduling algorithms.
4. Learn about Microcontroller and software tools in the embedded systems.
5. To introduce basics of RTOS and example tutorials to discuss on one RTOS tool.

UNIT 1: 8051 Microcontroller **Hours: 18**

8051Microcontroller: Introduction-8051Architecture-Input/Output Pins, Ports and Circuits- External Memory - Counters / Timers - Serial Data Input / Output –Interrupts

UNIT 2: Programming Basics **Hours: 18**

Instruction Set and Programming Moving Data-Addressing Modes-Logical operations- Arithmetic Operation-Jump and Call Instructions-Simple Program. Applications: Keyboard Interface- Display Interface-Pulse Measurements-DIA and AID Conversions-Multiple Interrupts.

UNIT 3: Concepts on RTOS **Hours: 18**

Concepts on RTOS: Introduction to RTOS-Selecting an RTOS-Task and Task states - Tasks and data-Semaphores and shared data. MORE operating systems services: Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions-Events - Memory Management-Interrupt Routines in an RTOS Environment.

UNIT 4: Design using RTOS **Hours: 18**

Basic Design using a RTOS: Principles - Encapsulating semaphores and Queues-Hard real time scheduling considerations-Saving memory space and power- introductions to RTL & QNX

UNIT 5: Software Tools **Hours: 18**

Software Tools: Embedded software Development Tools: Hosts and Target Machines-Linker/Locators for Embedded software-getting Embedded software into the Target systems.

Debugging Techniques: Testing on your Host machine -Instruction set simulators- The assert macro-using laboratory tools.

Text books:

1. David E.Simon, “An Embedded Softwareprimer” Pearson Education Asia, 2003.
2. KennethJAyala,”The8051MicrocontrollerandArchitectureprogrammingand application”, Second Edition, Penram International.

Reference Books:

1. RajKamal,“Embedded Systems –Architecture,programminganddesign”,TataMcGraw– Hill, 2003.

Related Online Contents[MOOC,SWAYAM,NPTEL,Websitesetc.]

1. https://onlinecourses.nptel.ac.in/noc20_cs14/preview
2. https://www.javatpoint.com/embedded-system-tutorial
3. https://www.tutorialspoint.com/embedded_systems/index.htm

COURSE OUTCOMES:

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

CO1	Understand the concept of 8051 microcontroller
CO2	Understand the Instruction Set and Programming
CO3	Analyze the concepts of RTOS
CO4	Analyze and design various real time embedded systems using RTOS
CO5	Debug the mal functioning system using various debugging techniques

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First Year (Semester – II)

Core Course IV – DATAMINING AND WAREHOUSING

Course Code: P2R3CSCC4	**Credit:** 5
Category: Core Course	**Hrs/Week:** 6, **Total Inst. Hrs:** 90
Nature of the Course: Employability	**Marks:** CIA: 25+ EXT: 75 = 100

COURSE OBJECTIVES

- Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.
- Develop skills of using recent data mining software for solving practical problems.
- Develop and apply critical thinking, problem-solving, and decision-making skills.
- Inculcate them knowledge about clustering and classification of data mining.
- Acquiring realization about data warehousing.

UNIT–I: Introduction Hours: 18

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–II: Classification Hours: 18

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

UNIT–III: Clustering Hours: 18

Clustering: Introduction–Similarity and Distance Measures – Outliers – Hierarchical Algorithms - 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–IV: Data warehousing Hours: 18

Data warehousing: 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 – multi-fact star schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.

UNIT–V: Developing Data warehousing Hours: 18

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.

COURSE OUTCOMES

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

- Understand the basic data mining techniques and algorithms
- Understand the Association rules, Clustering techniques and Data warehousing contents
- Compare and evaluate different data mining techniques like classification, prediction, Clustering and association rule mining
- Design data warehouse with dimensional modeling and apply OLAP operations
- Identify appropriate data mining algorithms to solve real world problems

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, Academic press. "Data Mining Concepts &Techniques"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	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

Core Course V – PYTHON PROGRAMMING

Course Code: P2R3CSCC5	**Credit:** 5
Category: Core Course	**Hrs/Week:** 6, **Total Inst. Hrs:** 90
Nature of the Course: Employability	**Marks:** CIA: 25+ EXT: 75 = 100

COURSE OBJECTIVES

- Presents an introduction to Python, creation of web applications, network applications and working in the clouds
- Use function for structuring Python programs
- Understand different Data Structures of Python
- Represent compound data using Python lists, tuples and dictionaries
- Gives an understanding about system concepts such as files, directories, networks etc.

UNIT – I : Introduction Hours: 18

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

UNIT–II: Code Structures Hours: 18

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–III: Modules, Packages, and Programs Hours: 18

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–IV: Data Types Hours: 18

Data Types: Text Strings–Binary Data. **Storing and Retrieving Data:** File Input/Output– Structured Text Files – Structured Binary Files - Relational Databases – No SQL Data Stores. **Web:** Web Clients –Web Servers–Web Services and Automation

UNIT–V: Systems Hours: 18

Systems: Files–Directories–Programs and Processes–Calendars and Clocks.

Concurrency: Queues– Processes–Threads–Green Threads and event–twisted–Redis. **Networks:** Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – ZeroMQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and MapReduce – Working in the Clouds.

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 Edition, 2009. Reference", Developer's Library.
2. Sheetal Taneja, Naveen Kumar, Approach", Pearson Publications. "Python Programming "

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

COURSE OUTCOMES

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

- Understand the basic data mining techniques and algorithms
- Understand the Association rules, Clustering techniques and Data warehousing contents
- Compare and evaluate different data mining techniques like classification, prediction, Clustering and association rule mining
- Design data warehouse with dimensional modeling and apply OLAP operations
- Identify appropriate data mining algorithms to solve real world problems

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

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Core Course VI – PYTHON PROGRAMMING LAB

Course Code: P2R3CSCC6P	**Credit: 4**
Category: Core Course	**Hrs/Week:** 6, **Total Inst. Hrs:** 90
Nature of the Course: Employability	**Marks:** CIA: 40 + EXT: 60 = 100

COURSE OBJECTIVES

- This course presents an overview of elementary data items, lists, dictionaries, sets and tuples
- To understand and write simple Python programs
- To Understand the OOPS concepts of Python
- To develop web applications using Python
- To learn developing modular programs in Python

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.

COURSE OUTCOMES

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

- Write programs in Python using OOPS concepts
- Understand the concepts of File operations and Modules in Python
- Implement the lists, dictionaries, sets and tuples as programs
- To develop web applications using Python
- Able to develop modular programs in Python

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

DISCIPLINE SPECIFIC ELECTIVE – III

1. COMPILER DESIGN

Course Code: P2R3CSDSE3:1	**Credit: 3**
Category: Core Course	**Hrs/Week:** 4, **Total Inst. Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- Discover principles, algorithms and techniques that can be used to construct various phases of compiler.
- Acquire knowledge about finite automata and regular expressions
- Learn context free grammars, compiler parsing techniques.
- Explore knowledge about Syntax Directed definitions and translation scheme
- Understand intermediate machine representations and actual code generation

UNIT–I: Lexical analysis **HOURS: 12**

Lexical analysis -Language Processors, The Structure of a Compiler, Parameter passing mechanism – Symbol table - The role of the lexical analyzer - Input buffering - Specification of tokens - Recognition of tokens–Finite automata-Regular expression to automata.

UNIT – II: Syntax Analysis **HOURS: 12**

Syntax Analysis - The role of the parser - Context-free grammars - Writing a grammar - Top down Parsing - Bottom-up Parsing - LR parsers- LALR parsers.

UNIT – III: Semantic Analysis **HOURS: 12**

Semantic Analysis - Inherited and Synthesized attributes – Dependency graphs – Ordering the evaluation of attributes – S- attributed definitions – L-attributed definitions – Applications of Syntax Directed translation – Syntax Directed translations schemes - Storage organization – Stack allocation of space.

UNIT–IV: Intermediate Code Generation **HOURS: 12**

Intermediate Code Generation - Variants of Syntax trees – Three Address code – Types and Declarations - Translation of Expressions – Type checking - Control flow - Back patching - Switch Statements - Procedure calls.

UNIT–V: Code Generation and Code Optimization **HOURS: 12**

Code Generation and Code Optimization - Issues in the design of a code generator - The target language – Address in the Target Code – Basic Block and Flow graphs – Optimization of Basic Blocks - A simple code generator – Peephole Optimization.

COURSE OUTCOMES

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

- List the various phases of compiler and its use
- Demonstrate compilation of coding
- Construct the steps in Intermediate code generation
- Develop the various code optimization techniques, and machine code generation
- Determine various parsing Technique

TEXTBOOK

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, "Compilers-Principles, Techniques and Tools", Second Edition, Pearson Education Asia, 2009.

REFERENCE BOOKS

1. A.V. Aho, Ravi Sethi, J.D. Ullman, Compilers-Principles, Techniques and Tools, Addison- Wesley, 2003.
2. Fischer Leblanc, Crafting Compiler, Benjamin Cummings, Menlo Park, 1988.
3. Kennath C. Louden, Compiler ConstructionPrinciples and Practice, Vikas publishing House, 2004.
4. Allen I. Holub, Compiler Design in C, Prentice Hall of India, 2001.
5. S. Godfrey Winster, S.Aruna Devi, R.Sujatha, "Compiler Design", yesdee Publishers, Third Reprint 2019.

WEB REFERENCES

1. https://www.geeksforgeeks.org/introduction-of-compiler-design/
2. https://www.guru99.com/compiler-design-tutorial.html
3. https://www.section.io/engineering-education/an-overview-of-compiler-design/

CO – PO MAPPING

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

2. BLOCKCHAIN TECHNOLOGY

Course Code: P2R3CSDSE3:2	**Credit: 3**
Category: Core Course	**Hrs/Week:** 4, **Total Inst. Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- Understand the fundamentals of block chain and crypto currency.
- Understand the influence and role of block chain in various other fields.
- Learn security features and its significance.
- Identify problems & challenges posed by Block Chain.
- Understand and handle the problems in Block chain technology.

UNIT I Introduction HOURS: 12

Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Crypto currencies 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 II BLOCK CHAIN AND MINING HOURS: 12

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 III CRYPTOCURRENCY AND BLOCK CHAIN HOURS: 12

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 IV CRYPTOCURRENCY AND BITCOIN HOURS: 12

Cryptocurrency Regulation-Stake holders, Roots of Bitcoin, Legal views-exchange of cryptocurrency-Black Market-Global Economy, Cyrpto economics–assets, supply and demand, inflation and deflation – Regulation.

UNIT V CHALLENGES IN BLOCKCHAIN HOURS: 12

Opportunities and challenges in Blockchain – Application of block chain: Industry 4.0 – machine to machine communication –Datamanagementinindustry4.0–future prospects. Blockchain in Health 4.0 - Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using blockchain for healthcare data.

COURSE OUTCOMES

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

- Demonstrate block chain technology and cryptocurrency
- Understand the mining mechanism in blockchain
- Apply and identify security measures and various types of services that allow people to trade and transact with bitcoins
- Apply and analyze Block chain in health care industry
- Analyze security, privacy, and efficiency of a given Block chain system

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. Rodri goda 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

3. DISTRIBUTED TECHNOLOGIES

Course Code: P2R3CSDSE3:3	**Credit: 3**
Category: Core Course	**Hrs/Week:** 4, **Total Inst. Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- To have an understanding about server controls
- To acquire knowledge about page code page controls, and components
- To gain knowledge about validation controls of dot net
- To understand Display dynamic data from a data source by using ADO.NET and data binding and Debug .NET Active Server Page
- To attain an notable knowledge level in ADO.Net and XML

Unit – I **Understanding and starting ASP.Net** **HOURS: 12**

Understanding the .Net framework: Benefits of .net framework – Elements of the .net framework. Getting started with ASP.NET: Introducing the .net Framework – Introducing ASP.net – Setting up the development environment – Creating an ASP.net application.

Unit – II **Web controls and Rich Web controls** **HOURS: 12**

Introducing ASP.Net web forms – Creating web forms application projects – Using web controls. Using Rich web controls: Using the AdRotator control – Using the Calendar control.

Unit – III **Validation controls** **HOURS: 12**

Validating user Input: Understanding validation controls – Using the RequiredFieldValidator control - Using the CompareValidator control - Using the RangeValidator control - Using the RegularExpressionValidator control - Using the CustomValidator control - Using the ValidationSummary control.

Unit – IV **ADO.NET** **HOURS: 12**

Introducing ADO.NET: ADO.NET basics - ADO.NET object model – Changes from ADO – Communicating with OLEDB data sources using ADO.NET.

Unit – V **XML and ASP.NET security** **HOURS: 12**

Advanced data binding and XML: Introduction to xml – An overview of xml related specifications – Support for xml in ASP.Net. ASP.NET security: Introduction to ASP.NET security – Form based authentication – Integrating security methods – Role based security.

COURSE OUTCOMES

After studying this course the students would be able to

- Get a clear understanding about .net framework.
- Gain knowledge about all the controls used in.net.
- Understand the validation controls of .net
- Acquire knowledge about the security features of .net framework.
- Know the data base support of .net.

Text Book:

1. ASP.NET Bible by Mridula Parihar et al. ,WILEY dream tech India Pvt. Ltd., Reprint 2002. [**Unit I** –Chapters 1,2; **Unit II** – Chapters 3,4; **Unit III** –Chapters 6; **Unit IV** –Chapters 8; **Unit V** – Chapters 13,19]

Reference books:

1. Programming with C#.Net by J.G.R. Sathiaseelan and N. Sasikala Devi, PHI, 2009.
2. The Complete Reference ASP.Net by Matthew MacDonald, McGraw Hill Education Pvt. Ltd. ,Indian Edition,2002
3. Build your own ASP.Net website using VB and C# by Christian Darie, Wyatt Barnett and Tim Posey, 4th Edition.

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

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DISCIPLINE SPECIFIC ELECTIVE – IV

1. WEB SERVICES

Course Code: P2R3CSDSE 4:1	**Credit: 3**
Category: Core Course	**Hrs/Week: 4**, **Total Inst. Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- Present the Web Services , Building real world Enterprise applications using Web Services with Technologies like SOAP , WSDL , UDDI
- To learn the connection between XML and web services
- Get overview of Distributed Computing, XML, and its technologies.
- Update with QoS and its features
- Develop Standards and future of Web Services

UNIT–I: Introduction **Hours: 12**

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– II: XML Fundamentals **Hours: 12**

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

UNIT– III: SOAP Model **Hours: 12**

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– IV: Technologies and Standards **Hours: 12**

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– V: Quality of Service **Hours: 12**

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.

COURSE OUTCOMES

After studying this course the students would be able to

- Understand web services and its related technologies
- Understand XML concepts
- Analyze on SOAP and UDDI model
- Demonstrate the road map for the standards and future of web services
- Analyze QoS enabled applications in web services

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. RameshNagappan,“DevelopingJavaWebServices:Architectinganddevelopingsecure Web Services Using Java”, John Wiley and Sons, first Edition Feb 2003.
2. EricAMarksandMarkJWerrell,“ExecutiveGuidetoWebservices”,JohnWileyand sons, March 2003.
3. AnneThomasManes,“WebServices:AmanagersGuide”,AddisonWesley,June2003.

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

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2. BIG DATA ANALYTICS

Course Code: P2R3CSDSE 4:2	**Credit: 3**
Category: Core Course	**Hrs/Week: 4**, **Total Inst. Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- To learn to analyze the big data using intelligent techniques
- To understand the various search methods visualization techniques
- To learn to use various techniques for mining data stream
- To learn and understand MapReduce and its implementation
- To learn about data warehousing management

Unit – I **Getting an Overview of Big Data** **Hours: 12**

What is Big Data- Evaluation of Big Data- Structuring Big Data- Elements of Big Data-Big Data Analytics-Careers in Big Data-Future of Big Data- Use of Big Data in social networking- Use of Big Data in preventing fraudulent activities-Use of Big Data in deducting fraudulent activities in insurance sector-use of Big Data in retail industry**.**

Unit – II **Introducing technologies for handling Big Data** **Hours: 12**

Distributed and parallel computing for Big Data – Introducing Hadoop – cloud computing and big data – in-memory computing technology for big data- Hadoop Ecosystem – Hadoop distributed file system – MapReduce- Hadoop YARN – introducing HBase- combining HBase and HDFS – HIVE –pig and pig latin – Sqoop – Zookeeper – Flume –Oozie.

Unit – III **Understanding MapReduce fundamentals and HBase** **Hours: 12**

The map reduce Framework – techniques to Optimize MapReduce jobs – Uses of MapReduce – role of HBase in Big Data processing – Exploring the big data stack – virtualization and big data – virtualization approaches

Unit – IV **Storing data in Database and Data warehouses** **Hours: 12**

RDBMS and Big Data – Non-Relational Database – polyglot persistence – Integrating Big Data with traditional Data warehouses – Big data analysis and data warehouse – Changing deployment models in big data – recollecting the concept of map reduce framework-developing simple map reduce application – points to consider while designing map reduce

Unit – V **Customizing Map Reduce Execution and Implementing Map Reduce Program** **Hours: 12**

Controlling map reduce execution with input format – reading data with custom RecordReader-organizing output data with output format - customizing data with RecordWriter – optimizing map reduce execution with combiner – controlling reducer execution with partitioners –customizing the map reduce execution in terms of YARN – implementing a map reduce program for sorting text data –Debugging |Hadoop map reduce locally – performing unit testing for map reduce application – performing local application testing with eclipse – logging for Hadoop testing – Application Log processing - Defensive programming in map reduce

COURSE OUTCOMES

After completing the course, the students would be able to

- Analyze the big data using intelligent techniques.
- Understand the various search methods visualization techniques.
- Use various techniques for mining data stream.
- To implement MapReduce
- To implement data warehousing management

Text Book:

1. "Big Data Black Book" by DT. Editorial Services, Dream Tech Press, Reprint 2017

Reference Books:

1. "BIG DATA " by Judith S. Hurwitz , Alan Nugent, Dr.Fern Halper and Marcia, Kaulfman, Wiley Publication ,2014
2. "BIG DATA Imperactives :Enterprice Big data Ware house, BI Implementations and Analytics '' by soumentra Mohanty, Madhu Jagadeesh and Harsha Srivatsa, ApressMedia,Springer science + Business Media Newyork, 2013

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

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3. ADVANCED SOFTWARE ENGINEERING

Course Code: P2R3CSDSE 4:3	**Credit: 3**
Category: Core Course	**Hrs/Week: 4**, **Total Inst. Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- Introduce to Software Engineering, Design, Testing and Maintenance.
- Enable the students to learn the concepts of Software Engineering.
- Learn about Software Project Management.
- Acquire an understanding about Software Design.
- Know about various types of Software testing and their implementation.

UNIT–I : Introduction **Hours: 12**

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– II: Software Requirements **Hours: 12**

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– III: Project Management **Hours: 12**

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– IV: Software Design **Hours: 12**

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– V: Software Testing **Hours: 12**

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.

COURSE OUTCOMES

After completing the course, the students would be able to

- Understand about Software Engineering Process
- Understand about Software Project Management skills, design and quality management
- Analyze on Software Requirements and Specification
- Analyze on Software Testing, Maintenance and Software Re-Engineering
- Design and conduct various types and levels of software quality or a software project

Text Books:

1. An Integrated Approach to Software Engineering–Pankaj Jalote, Narosa Publishing House, Delhi, 3rd Edition.
2. Fundamentals of Software Engineering –Rajib Mall, PHIPublication,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

SKILL ENHANCEMENT COURSE – I

1. WEB PROGRAMMING

Course Code: P2R3CSSEC1:1	**Credit: 2**
Category: Core Course	**Hrs/Week: 4**, **Total Inst. Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- To study fundamental concepts of web
- To know about HTML and XHTML
- To understand the basics of Java script
- To learn and acquire knowledge on DOM
- To study the concepts of XML and CSS

UNIT–I: Fundamentals of Web **HOURS: 12**

Fundamentals of Web: Internet, WWW, Web Browsers, and Web Servers, URLs, MIME, HTTP, Security, The Web Programmers Tool box. XHTML: Origins and evolution of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basic text markup, Images, Hypertext Links, Lists, Tables.

UNIT–II: HTML and XHTML **HOURS: 12**

HTML and XHTML: Forms, Frames in HTML and XHTML, Syntactic differences between HTML and XHTML. CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The Box model, Background images, Theand tags, Conflict resolution.

UNIT–III: Java Script **HOURS: 12**

Java Script: Overview of JavaScript; Object orientation and JavaScript; General syntactic characteristics; Primitives, Operations, and expressions; Screen output and keyboard input; Control statements; Object creation and Modification; Arrays; Functions; Constructor; Pattern matching using expressions; Errors in scripts; Examples

UNIT–IV: Java Script and HTML Documents **HOURS: 12**

Java Script and HTML Documents: The Java Script execution environment; The Document Object Model; Element access in Java Script; Events and event handling; Handling events from the Body elements, Button elements, Textbox and Password elements; The DOM2 event model; The navigator object; DOM tree traversal and modification.

UNIT–IV: Dynamic Documents with JavaScript **HOURS: 12**

Dynamic Documents with JavaScript: Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging and dropping elements. XML: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets; XML Processors; Web services.

COURSE OUTCOMES

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

- Describe fundamental concepts of Web and Design web pages
- Experiment with HTML and XHTML
- Design web pages using Java script
- Access and Utilize DOM in real time applications
- Demonstrate on the concepts of XML and CSS

TEXT BOOKS

1. "Building Web Applications" NIIT, Prentice –Hall of India (P) Ltd., New Delhi – 2008.
2. "World Wide Web design with HTML", C.Xavier, Tata McGraw – Hill Publishing Company Limited, New Delhi.
3. "Web Technology - A Developer's Perspective", N.P.Gopalan and J.Akilandeswari, PHI Learning Private Limited.

WEB REFERENCES

1. https://www.w3schools.com/whatis/
2. https://www.edureka.co/blog/web-development-tutorial/
3. https://www.geeksforgeeks.org/web-development/

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	M	S	S	M	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	L

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

2. REACT JS

Course Code:P2R3CSSEC1:2	**Credit: 2**
Category: Skill Enhancement Course	**Hrs/Week: 4**, **Total Inst. Hrs:** 60
Nature of the Course: SKILL DEVELOPMENT	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- To understand the need for ReactJS
- To acquire knowledge about Components, Forms of ReactJS
- To understand the Server-Side Rendering of ReactJS
- To learn about the Performance and React AJAX call
- To understand the concepts of AJAX with ReactJS and React forms

Unit – I **Introduction to ReactJS, Components, Typescripts, state** **Hours: 12**

Introduction to ReactJS: What is ReactJS? - Installation or Setup - Stateless Functions - Creating Reusable Components - Hello World Component – **Components**: Creating Components – nesting Components - Component states. **Using ReactJS with TypeScript:** ReactJS component written in TypeScript - Installation and Setup - Stateless React Components - **State in React:** Basic State – Antipattern - setState() - State, Events And Managed Controls.

Unit – II **Props, Components, Forms, React Boilerplate** **Hours: 12**

Props in React : Introduction - Default props – PropTypes - spread operator - Props.children and component composition – children components . **React Component Lifecycle:** Component Creation - Component Removal - Component Update - Lifecycle method call in different states - React Component Container. **Forms and User Input:** Controlled Components - Uncontrolled Components. **React Boilerplate:** react-starter project - Setting up the project.

Unit – III ReactJS with jQuery, React Routing, Components, basic webpack Hours: 12

Using ReactJS with jQuery: ReactJS with jQuery - **React Routing:** Example Routes.js file - React Routing Async - **Communicate Between Components:** Communication between Stateless Functional Components - **How to setup a basic webpack, react and babel environment:** How to build a pipeline for a customized "Hello world" with images.

Unit – IV React AJAX call, Components communication, function **Hours: 12**

React.createClass vs extends React.Component: Create React Component - "this" Context - Default Props and PropTypes - Mixins - Set Initial State - React “this” keyword with ajax - **React AJAX call:** HTTP GET request - HTTP GET request and looping through data - Ajax in React without a third party library. **Communication Between Components:** Child to Parent Components - Not-related Components - Parent to Child Components. **Stateless Functional Components:** Stateless Functional Component.

Unit – IV **Server-Side Rendering, Setting Up React Environment** **Hours: 12**

Performance : Performance measurement with ReactJS - React's di□ algorithm - HTML DOM vs

Virtual DOM - Tips & Tricks. **Introduction to Server-Side Rendering:** Rendering components - **Setting Up React Environment:** Simple React Component - Install all dependencies - Configure webpack - Configure babel - HTML file to use react component - Transpile and bundle your component.

Unit – V **JSX, React Forms** **Hours: 12**

Using React with Flow: Using Flow to check prop types of stateless functional components - Using Flow to check prop types – **JSX:** Props in JSX - Children in JSX - **React Forms:** Controlled Components.

COURSE OUTCOMES

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

- Learn ReactJS basics, Components, Type scripts and state
- Develop jQuery and React Routing
- Define classes, AJAXapp with ReactJS
- Construct their own React applications
- Analyze and Interpret Server-side rendering with react environment

Text book:

1. React JS Notes for Professionals, Stack Overflow Documentation.

Reference Book

1. Learning React: Functional Web Development with React and Redux: by Adam Boduch
2. The Road to React: The React.js with Hooks in JavaScript Book (2023 Edition): by Robin Wieruch
3. React JS: From Basics to Advanced - A Comprehensive 3-in-1 Guide to Effortless Web Development for Beginners, Intermediates, and Experts: by Vivian Walker

Web references:

1. file:///C:/Users/Admin/Downloads/ReactJSNotesForProfessionals.pdf
2. https://books.goalkicker.com/ReactJSBook/#google_vignette
3. Chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://sd.blackball.lv/library/Learning_React_(2020).pdf

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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

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3. WAP and XML

Course Code: P2R3CSSEC1:3	**Credit: 2**
Category: Skill Enhancement Course	**Hrs/Week: 4**, **Total Inst. Hrs:** 60
Nature of the Course: SKILL DEVELOPMENT	**Marks:** CIA: 25 + EXT: 75 = 100

COURSE OBJECTIVES

- To provide the students with setting up of WAP
- To inculcate the knowledge of WAP gateways and WML basics
- To give them the exposure of using WML scripts
- To educate the students about XML scripts
- To teach the students about the rules, attributes of XML tags

UNIT–I: Overview of WAP **HOURS: 12**

Overview of WAP: WAP and the wireless world – WAP application architecture – WAP internal structure – WAP versus the Web – WAP1.2 – WTA and push features. Setting up WAP: Available software products – WAP resources – The Development Toolkits.

UNIT–II: WAP gateways **HOURS: 12**

WAP gateways: Definition – Functionality of a WAP gateway – The Web model versus the WAP model – Positioning of a WAP gateway in the network – Selecting a WAP gateway Basic WML: Extensible markup language – WML structure – A basic WML card – Text formatting – navigation – Advanced display features.

UNIT–III: Interacting with the user **HOURS: 12**

Interacting with the user: Making a selection – Events – Variables – Input and parameter passing. WML Script: Need for WML script – Lexical Structure – Variables and literals – Operators – Automatic data type conversion – Control Constructs Functions – Using the standard libraries – programs – Dealing with Errors.

UNIT– IV: XML **HOURS: 12**

XML: Introduction XML: An Eagle's Eye view of XML – XML Definition List of an XML Document – Related Technologies – An introduction to XML Applications – XML Applications – XML for XML – First XML Documents Structuring Data: Examining the Data XMLizing the data – The advantages of the XML format – Preparing a style sheet for Document Display.

UNIT–V: Attributes, Empty Tags and XSL **HOURS: 12**

Attributes, Empty Tags and XSL: Attributes – Attributes Versus Elements – Empty Tags – XSL – Well formed XML documents – Foreign Languages and Non Roman Text – Non Roman Scripts on the Web Scripts, Character sets, Fonts and Glyphs – Legacy character sets– The Unicode Character set – Procedure to Write XML Unicode.

COURSEOUTCOMES

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

- Apply XML concepts to develop Web application Use WAP gateways
- Develop SOAP application using XML and Web Services
- Define XML and WML elements efficiently
- Construct their own WML scripts
- Analyze and Interpret XML scripts

TEXTBOOKS

1. **For Unit I, II, III**
   a. Charles Arehart and Others. "Professional WAP with WML, WML script, ASP, JSP,XML, XSLT, WTA Push and Voice XML" ShroffPublishersandDistributersPvt.Ltd2000.
2. **For Unit IV&V**
   a. Eliotte Rusty Harlod "XML TM Bible", Books India(P)Ltd, 2000

REFERENCE BOOKS

1. HeatherWilliamson,"XML:TheCompleteReference",TataMcGraw-HillEducationIndia.
2. Thomas Connolly, Carolyn Begg., "Database Systems a practicalapproachtoDesign,InmplementationandManagement",PearsonEducation,2014.

WEB REFERENCES

1. https://developpaper.com/wap-tutorial-1-introduction-to-wap-xml-xslt/
2. https://docstore.mik.ua/orelly/web2/wdesign/ch32_01.htm
3. http://xml.coverpages.org/wap-wml.html

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

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