

M. SC. COMPUTER SCIENCE

Syllabus
(With effect from 2020-21)

Program Code :



DEPARTMENT OF COMPUTER SCIENCE
Bharathiar University
(A State University, Accredited with “A” Grade by
NAAC and 13th Rank among Indian Universities by
MHRD-NIRF)
Coimbatore 641 046, INDIA

BHARATHIAR UNIVERSITY : : COIMBATORE 641046

**DEPARTMENT OF COMPUTER SCIENCE
(Effective from the academic Year 2020 - 2021)**

MISSION

- Creating and disseminating of world class knowledge in global context
- Equip students with knowledge on up-to-date technological developments to take part in global software industry
- Promote state of art inter disciplinary research in computer science
- Imbibe entrepreneurial culture through curriculum, pedagogy, research and mentoring

1. Eligibility for Admission to the Programme

Candidates for admission to the first year programme leading to the Degree of Master of Science in Computer Science (M.Sc. – CS) will be required to possess:

A pass in B.Sc. Computer Science/ Information Technology/ Computer Applications or its equivalents.

2. Duration of the Programme

The programme shall be offered on a full-time basis. The programme will consist of three semesters of course work and laboratory work and the fourth semester consists of project work.

3. Regulations

The general Regulations of the Bharathiar University Choice Based Credit System Programme are applicable to this programme.

4. The Medium of Instruction and Examinations

The medium of instruction and Examinations shall be in English.

5. Submission of Record Notebooks for Practical Examinations & Project Viva-Voce.

Candidates taking the Practical Examinations should submit bonafide Record Note Books prescribed for the Examinations. Otherwise the candidates will not be permitted to take the Practical Examinations.

Candidates taking the Project Viva Examination should submit Project Report prescribed for the Examinations. Otherwise the candidates will not be permitted to take the Project Viva-voce Examination.

Program Educational Objectives (PEOs)	
The M. Sc. Computer Science program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Employed in software industry and engaging in understanding and applying new ideas and thoughts as the field evolves
PEO2	Promotion of inter disciplinary research for inventions/innovations for professional careers to meet the needs of the society
PEO3	Enhanced to cope up with the changing technologies in the frontier of computer science and allied field
PEO4	Incorporating Industry 5.0 Technologies in their career based on industry needs

Program Specific Outcomes (PSOs)	
After the successful completion of M.Sc Computer Science program, the students are expected to	
PSO1	Take up higher education in top Institutions
PSO2	Get expertise in developing smart applications
PSO3	Get career opportunities as Data Scientist/ Data Analyst
PSO4	Become an entrepreneur in designing and development
PSO5	Demonstrate proficiency in problem solving techniques using Industry 4.0 and Industry 5.0

Program Outcomes (POs)	
On successful completion of the M. Sc. Computer Science program	
PO1	Gain and apply the knowledge of computer science concepts in appropriate domain of interest
PO2	Ability to analyze the problem, identify the required computing facility and implement it to obtain solutions
PO3	Ability to create a new design for the complex computational problems which meets the specific needs for environmental and societal impact domains
PO4	Students can independently enable to acquire the innovative ideas and solve complex real-time problems by considering professional, ethical, legal and social issues
PO5	Understand and choose the appropriate modern techniques and tools for the complex systems of various domains and understands the advantages and limitations
PO6	Ability to work in a group with an effective rapport building with team members in computer industries to accomplish a common goal
PO7	Ability to communicate effectively in the basis of presenting their research work and gain knowledge on documentation and reports writing in a professional way
PO8	Ability to distinguish the ethical, legal and societal issues of computing surroundings and will take the responsibility by applying computer skill practices
PO9	Ability to analyze the local and global impact of computing on individuals, organizations and society
PO10	Demonstrate the principles of computer science and apply these in the multidisciplinary environments to manage project

BHARATHIAR UNIVERSITY : : COIMBATORE 641 046
M.Sc Computer Science Curriculum (UniversityDepartment)
(For the students admitted during the academic year 2020 – 21 onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
20CS1C1	Advanced Operating System	4	4	-	25	75	100
20CS1C2	Data Structures and Algorithms	4	2	4	25	75	100
20CS1C3	Advanced Java Programming	4	2	4	25	75	100
20CS1C4	Python Programming	4	2	4	25	75	100
20CS1C5	Compiler Design	4	4	-	25	75	100
20CS1EX	Elective – I	4	4	-	25	75	100
	Industry Literacy	1					25
	General Supportive - I	2					50
	Job Oriented Course	2					
Total		29					700
SECOND SEMESTER							
20CS2C1	Linux Programming	4	2	4	25	75	100
20CS2C2	Information Security	4	4	-	25	75	100
20CS2C3	Internet of Things	4	4	-	25	75	100
20CS2C4	Data Mining Techniques and Tools	4	2	4	25	75	100
20CS2C5	Database Management and Administration	4	2	4	25	75	100
20CS2EX	Elective - II	4	4	-	25	75	100
Basics of Research	Literature Survey	1					25
	General Supportive - II	2					50
	Job Oriented Course	2					
	Value Added Course	2					
Total		31					700
THIRD SEMESTER							
20CS3C1	Visual Programming	4	2	4	25	75	100
20CS3C2	Software Project Management	4	4	-	25	75	100
20CS3C3	Cloud Computing	4	4	-	25	75	100
20CS3C4	Big Data Analytics	4	2	4	25	75	100
20CS3C5	Wireless Networks	4	2	4	25	75	100
20CS3EX	Elective - III	4	4	-	25	75	100
Basics of Research	Gap Analysis	1					25
	General Supportive - III	2					50
	Value Added Course	2					
Total		29					700
FOURTH SEMESTER							
	Project Work	9					225

Total		9					
Grand Total							
ONLINE COURSES							
Online Course	R - Programming	2					50

Elective Papers

Sem.	Elective	Suggested Code	Title of the Paper	No. of Credits
I	Elective - I	20CS1E1	Mathematical Foundations for Computer Science	4
		20CS1E2	Parallel Processing	4
		20CS1E3	Web Services	4
II	Elective – II	20CS2E1	Operation Research	4
		20CS2E2	Image Processing	4
		20CS2E3	Mobile Communication	4
III	Elective – III	20CS3E1	Machine Learning	4
		20CS3E2	E-Commerce	4
		20CS3E3	Open Source Technologies	4

Supportive Papers

Suggested Code	Sem	Title of the paper	Hrs	Credits	Marks
20CSS01	I/II/III	Windows and MS Word	2	2	50
20CSS02		Internet and HTML Programming	2	2	50
20CSS03		Relational Database Management System	2	2	50
20CSS04		Object Oriented Programming	2	2	50
20CSS05		Software Engineering	2	2	50
20CSS06		Multimedia Systems	2	2	50

List of Job Oriented/Value Added Course

1. Mobile Application Development
2. Smart Applications with Internet of Things
3. Augmented Reality
4. Remote Sensing and GIS

Course Code	20CS1C1	ADVANCED OPERATING SYSTEMS	L	T	P	C
Core/Elective/Supportive	CORE		4	0	0	4
Pre-requisite	Fundamentals of Operating Systems		Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To review the basic concepts of operating system and to introduce the advanced concepts.						
2. To discuss about process synchronization, distributed operating systems, real time operating systems, operating system for handheld systems, LINUX OS and iOS.						
3. To inculcate the working principles, features, various services and limitations of different types of operating system.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the functions, types, advanced concepts in operating system, and the process concepts. Analyze deadlock situations, the reason for deadlock, recovery of deadlocks and how to avoid deadlocks.				K2/K4	
2	Understand and analyze the concepts of distributed operating systems, issues and file system coding in distributed system.				K2/K4	
3	Analyze the need of Real time operating system and describe about security issues and applications of real time operating system.				K2/K4	
4	Understand how to use the Palm OS and Android in handheld devices.				K2/K3/K4	
5	Understand the information about the Linux operating system and iOS architecture, layers and their functions.				K2/K3/K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Process Synchronization				12 hours	
Overview - Introduction – Functions of an operating system – Design approaches – Why advance operating systems – Types of advanced operating systems. Synchronization mechanisms: Introduction – Concept of a process – Concurrent processes – The critical section problem – Other synchronization problems. Process deadlocks: Introduction – preliminaries – models of deadlocks						
Unit:2	Distributed Operating Systems				10 hours	
Issues – Communication Primitives – Lamport’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 Systems				15 hours	
Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling						
Unit:4	Operating Systems for Handheld Systems				10 hours	
Requirements – Technology Overview – Handheld Operating Systems – Palm OS - Android – Architecture of android – Securing handheld systems						
Unit:5	Linux and iOS				11 hours	
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				2 hours	
Discussion on case study - Expert lectures - Online seminars – Webinars - Workshops						

	Total Lecture hours	60 hours
Text Books		
1	MukeshSinghal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill Publishers, 2011	
2	Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India Publishers, Second Edition, 2008.	
3	Daniel.P.Bovet& Marco Cesati, ”Understanding the Linux kernel”, O’ReillyPublishers , 3rd edition, 2005	
Reference Books		
1	Neil Smyth, “iPhone iOS 4 Development Essentials – Xcode”, Payload media Publishers, Fourth Edition 2011	
2	YoonSeokPyo, HanCheol Cho, RyuWoon Jung, TaeHoon Lim, “ROS Robot Programming From the basic concept to practical programming and robot application”, ROBOTICS Co., Ltd, 2017.	
3	Pramod Chandra P.Bhatt, “An Introduction To Operating Systems, Concept And Practice”, PHI publishers, Third edition, 2013.	
4	Andrew S. Tanenbaum, “Modern Operating System”, Prentice-Hall, Inc, Third edition, 2008	
5	AnisKoubaa, “Robot Operating System (ROS) The Complete Reference (Volume 1)”, Springer Publishers, First Edition, 2016	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	http://nptel.ac.in/courses/Webcourse-contents/IIScBANG/Operating%20Systems/New_index1.html	
2	https://www.tutorialspoint.com/operating_system/index.htm	
3	https://www.coursera.org/courses?languages=en&query=operating+system	
4	https://in.udacity.com/course/advanced-operating-systems--ud189	
5	http://wiki.ros.org/ROS/Tutorials	
6	https://www.toptal.com/robotics/introduction-to-robot-operating-system	
Course Designed By: Dr. S.Vijayarani		

Mapping with programme outcomes:

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

S- Strong; M-Medium; L-Low

Course code	20CS1C2	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
Core/Elective/Supportive	CORE		2	0	4	4
Pre-requisite	Students should be able to program in any standard programming language		Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. Provide a good background in data structures and algorithms to prepare the students for job in industry						
2. Learn systematic way of solving the problems						
3. Solve the problems using data structures and algorithms						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Remember and Understand the fundamental data structures and implement them using programming languages				K1/K2	
2	Understand and Apply the time complexity of different problems				K2/K3	
3	Understand efficient data structures and apply them to solve the problems				K2/K3	
4	Analyze and Evaluate the various algorithms				K4/K5	
5	Understand and Create data structures and algorithms for various domains				K2/K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1						
DATA STRUCTURES BASICS			11hours			
Introduction: Definition, Structure and Properties of algorithms –Development of an algorithm – Data Structures and algorithms –Data Structure definition and classification. Analysis of algorithms: Efficiency of algorithms –A priori analysis –Asymptotic notations –Time complexity of an algorithm using O notation –Polynomial Vs Exponential algorithms –Average, Best and Worst-case complexities –Analyzing recursive programs.						
Unit:2						
STACK AND QUEUE			11hours			
Stacks: Introduction -Stack Operations –Applications –Recursion -Evaluation of Expressions. Queues: Introduction -Operations on Queues –Circular queues –Application of a linear queue. Linked Lists: Introduction - Singly linked lists -Circularly linked lists -Doubly linked lists - Applications –polynomial addition						
Unit:3						
TREES AND GRAPHS			12hours			
Binary Trees: Introduction –Representation of Trees –Binary Tree Traversals. Binary Search Trees: Introduction –Operations. AVL Trees: Definition -Operations. B-Trees: Introduction – m-way search trees -B trees definition and operations. Graphs: Introduction –Definitions – Representation of Graphs –Graph Traversal -Depth-First and Breadth-First Algorithms -Topological Sorting						
Unit:4						
ALGORITHM DESIGN TECHNIQUES I			12hours			

Divide and Conquer: General Method –Binary Search –Merge Sort –Quick Sort. Greedy Method: General Method –Knapsack Problem –Minimum Cost Spanning Tree –Single Source Shortest Path		
Unit:5	ALGORITHM DESIGN TECHNIQUES II	12hours
Dynamic Programming: General Method –Multistage Graphs –All Pair Shortest Path –Traveling Salesman Problem. Backtracking: General Method –8-Queens Problem –Sum of Subsets –Hamiltonian Cycles. Branch and Bound: The Method –0/1 Knapsack Problem –Traveling Salesperson		
Unit:6	CASE STUDY	02 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	TotalLecturehours	60hours
TextBook(s)		
1	GAV Pai, Data Structures and Algorithms Concepts, Techniques and Applications, Tata McGraw Hill, 2008.	
2	Robert Sedgewick, PhillipeFlajolet, “An Introduction to the Analysis of Algorithms”, Second Edition, Addison- Wesley Professional, 2013.	
Reference Books		
1	Jean Paul Tremblay, Paul G. Sorenson, An Introduction to Data Structures with Applications, Tata McGraw Hill, Second Edition.	
2	SartajSahni, “Data Structures, Algorithms and Applications in C++”, Second Edition, Universities Press, 2005.	
3	Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, “Fundamentals of Computer Algorithms”, Second Edition, Universities Press, 2008.	
RelatedOnlineContents[MOOC, SWAYAM, NPTEL, Websitesetc.]		
1	https://swayam.gov.in/nd1_noc20_cs10/preview	
2	Hsuan – Hao Hsu, Chen – Hsuan Huang, and Shiang – Tai Lin, 2019, New data structure for computational molecular design with atomic or fragment resolution, J. Chem. Inf. Model, 59 (9), 3703-3713. Available at: https://pubs.acs.org/doi/abs/10.1021/acs.jcim.9b00478	
CourseDesigned By:Dr.D.Ramyachitra		

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

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

Course code	20CS1C3	ADVANCED JAVA PROGRAMMING	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basic Java, Object Oriented Programming concepts	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. To inculcate the students to understand the advanced JAVA concepts						
2. To develop Java based applications by applying these advanced concepts to implement in web based applications						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Create Applications using Swing Components.					K2/K3/K4/K6
2	Write distributed applications using RMI					K2/K3/K4/K6
3	Establishing DATABASE Connectivity using JAVA					K2/K3/K4
4	Understand the JavaScript language & the Document Object Model.					K2/K3/K4
5	Understand and apply Well-Formed XML and different types of XML Schemas					K2/K3/K6
6	Understand AJAX					K2/K3/K4
7	Create application using Servlets and JSP					K2/K3/K4/K6
8	Understand Struts, Spring and Hibernate frameworks					K2
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Java Swing				9 -- hours	
Features – Classes and Packages – MVC architecture – Swing basic components – Buttons – Labels – List – Combo box – Menu Simple AWT application using Swing Components.						
Unit:2	Remote Method Invocation and JDBC				10-- hours	
RMI overview - RMI architecture - Example demonstrating RMI. Database Handling:Accessing Database using JDBC.						
Unit:3	JAVA in WEB				12-- hours	
Java Scripts: JavaScript language syntax, Built In Functions, HTML Forms, HTML DOM, XML: XML documents, XML schemes, and Extensible Style Language (XSL), Introduction to AJAX.						
Unit:4	Servlet And Jsp				18-- hours	
Servlet: Introduction to servlet - Developing and Deploying Servlets - Handling Request and Response - Reading Servlet Parameters - Cookies - Session Tracking. Java Server Pages: Basic JSP Architecture - Life Cycle of JSP - JSP Tags and Expressions – Directives- JSP applications. Java Creating and using JavaBean components –Setting and retrieving JavaBean components – Java Server Faces Application.						

Unit:5	Hibernate, Spring, Struts	9-- hours
Introduction to Hibernate – Advantages – Architecture –Spring Framework -Struts Framework: Introduction to Struts- Struts Architecture.		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60-- hours
Text Books		
1	Herbert Schildt - JAVA 2 (The Complete Reference)- Ninth Edition, TMH, 2014	
2	Jim Keogh, “The Complete Reference J2EE, Tata McGraw-Hill, 2002.	
Reference Books		
1	Brian Cole, Robert Eckstein, James Elliott, Marc Loy, David Wood, Java Swing, O’Reilly Publishers, second edition, 2002	
2	Patrick Naughton, “The Java Hand Book, Tata McGraw Hill, 1996.	
3	KogentSolutionss, Java Server Programming Java Ee5 Black Book,Dreamtech Press, 2008	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/javascript	
2	https://www.tutorialspoint.com/java_xml	
3	https://www.tutorialspoint.com/ajax	
4	https://www.w3schools.com/	
Course Designed By: Dr. K. Geetha		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	S	L	S	L	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	S	S	L	L	M	S	S	S	S
CO4	S	S	S	M	S	S	S	M	S	M
CO5	S	S	S	L	M	S	S	S	S	S
CO6	S	S	S	M	S	S	S	S	S	S
CO7	S	S	S	S	S	S	M	M	S	M
CO8	S	S	M	M	M	M	S	S	L	S

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

Course code	20CS1C4	PYTHON PROGRAMMING	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Comprehensive knowledge and understanding of the basic components of Python programming language.	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide in depth knowledge about the basic concepts of Python programming.						
2. To discuss the principle of algorithm design to most high level programming languages.						
3. To design real life situational problems and think creatively about solutions of them.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Develop python programs for core python and data types using objects and functions. Develop python programs for list and control statements and understand the different loops such as “for”, “while”and “do-while”				K3 / K6	
2	Apply the Mapping and the Dictionary technique for the given problem. Implement File Objects and Object-Oriented Programming using python				K3 / K4	
3	Explain about the functions and packages involved in modules				K1 / K2	
4	Manage Errors and Exceptions and summarize the Network Programming.Be exposed to advanced applications such as Internet Client Programming and GUI Programming				K2 / K3/ K4	
5	Explain the basic concepts and need for Graph databases. Create databases and retrieve records using Neo4j. Provide the information about data visualization and its need.				K2 / K4/ K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1						
Core Python			10 hours			
Introduction-features-Comparative Study-Comments-Variables and Assignments. Python Objects: Standard types-Built-in-type Internal type-Standard type operator and Built-in functions-Categorizing standard type Unsupported type. Numbers: Introduction- Integer-Floating Point-Complex numbers-Operators-Built-in and factory functions. Sequences- Strings-Strings and Operator-String only operator- Built-in-Functions-Built-in-Methods-String Features-Unicode.						
Unit:2						
List			12 hours			
List-Operators-Built-in-Functions-Built-in-Methods-Features of List. Tuple: Introduction Operators and Built-in-Functions-Features of tuples-Copying Python Objects and shallow and deep copies. Mapping type: Dictionaries- mapping type Operators-Built-in and Factory Functions-Built-in-Methods- Dictionary Keys. Set type: Introduction Operators-Built-in Function-Built-in Methods-- Conditional and looping statement.						
Unit:3						
File			12 hours			
File Objects- Built in Functions-Methods-Attributes-Standard files-Command line Argument-File						

System-File Execution-Persistent Storage Modules. Object-Oriented Programming: Classes and Instance- Binding and Method Invocation-Static Methods and Class methods-Inheritance. Modules: Modules and Files-Namespace-Importing Modules- Features-Built-in Functions-Packages.		
Unit:4	Errors and Exceptions	12 hours
Exceptions in python-Detecting and Handling Exceptions- Context Management-Raising Exception Assertions. Regular Expression: Introduction-Special Symbols and characters-Regexes and Python Examples of Regexes. Network Programming: Introduction-Socket.		
Unit:5	Internet Client Programming	12 hours
Transferring files-Email. Multi-threaded Programming: Threads and Processes- Global Interpreter Lock-Thread Module- Threading Module. GUI Programming: Introduction-Tkinter and Python. DB Programming: Introduction-Python DB- API-Object Relational Managers (ORM).		
Unit:6	Industry 4.0	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Books		
1	Aditya Kanetkar, Let Us Python, bpb publications, 2020	
2	Harsh Bhasin, Python for Beginners, New Age International (P) Ltd Publishers, 2018	
Reference Books		
1	Al Sweigart, Automate the Boring Stuff with Python: Practical Programming for Total Beginners, 2015	
2	Martin C. Brown, Python The Complete Reference	
3	O'Reilly Media, Learning Python, 5th Edition Fifth Edition, 2013	
4	Beazley David, Python Essential Reference, Pearson Education (US), 2009	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/ndl_noc19_cs59/preview	
2	https://www.python.org/	
3	https://www.tutorialspoint.com/python/index.htm	
4	https://nptel.ac.in/courses/106/106/106106182/	
5	https://www.w3schools.com/python/	
Course Designed By: Dr. D.NAPOLEON		

Mapping with programme outcomes:

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

S- Strong; M-Medium; L-Low

Course Code	20CS1C5	COMPILER DESIGN	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Basic knowledge on computational theory (Automata and Grammar).	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To understand the fundamentals of Internet of Things						
2. To learn about the basics of IoT protocols						
3. To apply the concept of Internet of Things in the real world scenario.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Remember the different phases of a compiler and the principles behind each phase.			K1/K2		
2	Understand the concepts of regular expressions, automata and apply the same to implement lexical analyzer using LEX tool.			K1/K2/K3		
3	Understand the concepts of context free grammars and able to know the LR parsers and various methods to generate intermediate code.			K2/K3/K4		
4	Analyze semantic rules into a parser that performs attribution while parsing.			K1/K3		
5	Understand how the code is optimized and the target code is generated.			K3 /K5		
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;						
Unit:1	Introduction to Compilers			8hours		
Translators-Compilation and Interpretation-Language processors –The Phases of Compiler-Errors Encountered in Different Phases-The Grouping of Phases Compiler Construction Tools – Programming Language basics.						
Unit:2	Lexical Analysis			10hours		

Need and Role of Lexical Analyzer-Lexical Errors-Expressing Tokens by Regular Expressions Converting Regular Expression to DFA- Minimization of DFA Language for Specifying Lexical Analyzers-LEX-Design of Lexical Analyzer for a sample Language.		
Unit:3	Syntax Analysis	1 8 hours
Need and Role of the Parser-Context Free Grammars –Top Down Parsing –General Strategies Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser- LR (0)Item Construction of SLR Parsing Table –Introduction to LALR Parser – Error Handling and Recovery in Syntax Analyzer-YACC-Design of a syntax Analyzer for a Sample Language.		
Unit:4	Syntax Directed Translation & Run Time Environment	13hours
Syntax directed Definitions Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute Definitions- Design of predictive translator – Type Systems-Specification of a simple type checker Equivalence of Type Expressions-Type Conversions – Run-Time Environment: Source Language Issues Storage Organization-Storage Allocation Parameter Passing-Symbol Tables-Dynamic Storage Allocation.		
Unit:5	Code Optimization and Code Generation	9 hours
Optimization-DAG Optimization of Basic Blocks-Global Data Flow Analysis Efficient Data Flow Algorithms Issues in Design of a Code Generator – A Simple Code Generator Algorithm.		
Unit:6	Applications and Case Studies	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Book(s)		
1	Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, “Compilers – Principles, Techniques and Tools”, Edition, Pearson Education, 2014.	
Reference Book(s)		
1	Steven S. Muchnick, “Advanced Compiler Design and Implementation”, Morgan Kaufmann Publishers an imprint of Elsevier 2014	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1.	http://nptel.ac.in/downloads/106108113/	
2.	https://www.intel.com/content/dam/www/programmable/us/en/pdfs/literature/hb/hls/ug-hls.pdf	
3.	https://hal.archives-ouvertes.fr/hal-02423363/file/hal-hls-arith-v2.pdf	
Course Designed By: Dr.P.B.Pankajavalli		

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

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

Course code	20CS2C1	LINUX PROGRAMMING	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Fundamentals of Operating systems and basics of C language.	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. Provide the strong foundation to students on open source Linux operating system basics system calls and library.						
2. Enrich their knowledge on handling processes,threads, signals and synchronization.						
3. Train the students to equip their knowledge in Inter-process communications and networking using pipes, named pipes, shared memory, message queue, semaphore and TCP and UDP sockets.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand about Unix and Linux history, Unix architecture, GNU, Free software foundation, Distributions, Work with files and directories.					K1/K2
2	Create simple shell scripts, work with files using shell scripts and understand system calls and library functions and create applications using c language.					K2/K3
3	Understand about processes, process structure, Analyze the process states, process controls and process relationships and zombie process					K2/K4/K3
4	Exploring the concepts of signals and threads and illustrate the use of signals and threads and also examine the use of inter-process communication facilities in Linux such as pipes, named pipes and message queues.					K2/K3/K4 /K6
5	Design and develop the client/server applications using shared memory with semaphores and also understand sockets and create network based applications using TCP and UDP sockets.					K3/K2/K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6– Create						
Unit:1	Introduction to UNIX and Linux					12 hours
History-Architecture of UNIX operating system- Features of UNIX- Basic commands- Working with files and directories- Commands- File types- File access processes permissions redirection-filters- What is Linux?- Distributions- The GNU Project and the Free Software Foundation						
Unit:2	Shell Programming in Linux and System Calls and Library					12 hours
VI editor- Shell syntax- variables- conditions and control structures- command execution- simple programs- System calls and library: Read- Write- File and record locking- Adjusting the position of file I/O- Lseek- Close- File creation- Creation of special files- Changing directory, root, owner, mode- stat and fstat						
Unit:3	Processes and Signals					12 hours
Introduction of process- Process structure- Process states- Process termination- command line arguments- Process control- Process identifiers- Process relationships- Zombie process- Signals: Sending signals- Signal sets- Threads: Synchronization- Thread attributes- Cancelling Threads						

Unit:4	Inter Process Communication	12 hours
Communication between related processes - popen() and pclose()- Pipes- Communication between unrelated processes - Named pipes (FIFO)- Message queues- Semaphores, Synchronization- Shared Memory- Developing Client-Server applications using IPC		
Unit:5	Sockets	10 hours
Introduction to Sockets –Types of socket - Socket Connections- TCP sockets- TCP echo client server- UDP sockets- UDP echo client server- Socket options		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Book(s)		
1	Petersen and Richard, LINUX: The Complete Reference, Sixth edition, McGraw Hill, 2007.	
2	Richard Stones, Neil Matthew, Beginning Linux Programming, Fourth edition, Wiley, 2008.	
3	W. Richard Stevens, Bill Fenner, Andrew Rudoff, UNIX Network Programming, Vol. 1, The Sockets Networking API, Third Edition, Pearson education, Nov 2003.	
Reference Books		
1	Richard Blum, Linux Command Line and Shell Scripting Bible, Wiley Publishing, Inc., Indianapolis, Indiana, 2008.	
2	Sean Walton, Linux Socket Programming, Sams Publisher, I edition, 2001.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/unix	
2	https://lecturenotes.in/subject/455/linux-programming-lp	
3	https://linuxconfig.org/linux-command-line-tutorial	
4	https://www.guru99.com/unix-linux-tutorial.html	
Course Designed By: Dr. R. Porkodi		

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

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

Course code	20CS2C2	INFORMATION SECURITY	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Knowledge in the field of computers and Internet	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. Inculcate the student knowledge in information security.						
2. To familiarize them about possible threats and vulnerabilities to the system.						
3. Enhance their skill in handling risks and ability to advise an individuals seeking protection to their data.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand Information Security, the various phases of the security systems development life cycle and the issues facing by software developers					K2
2	Understand the functions of and relationships among laws, regulations, and professional organizations in information security and to differentiate between laws and ethics					K2
3	Understand risk identification, risk management and risk control Analyze risks based on probability of occurrence Understand the existing conceptual frameworks for evaluating risk controls Do benefit analysis					K2/K4
4	Understand information security blueprint, identify its major components Understand how an organization institutionalizes its policies, standards, and practices using education, training, and awareness programs Understand what contingency planning is and how it relates to incident response planning, disaster recovery planning, and business continuity plans					K2
5	Understand role of access control in computerized information systems, and to identify and discuss widely-used authentication factors Understand and the use of virtual private networks					K2/K3
6	Understand the basic principles of cryptography and the most popular cryptographic tools Analyze the nature and execution of the dominant methods of attack used against cryptosystems					K2/K3/K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1		Introduction to Information Security			12-- hours	
History, What is Security, CNSS Security Model, Components of an Information System, Balancing Information Security and Access, The Systems Development Life Cycle, The Security Systems Development Life Cycle. Communities of interest-Need for security: Threats, Attacks.						
Unit:2		Legal, Ethical and Professional Issues			12-- hours	
Law and Ethics in Information Security, International Laws and Legal Bodies, Ethics and Information Security, Codes of Ethics and Professional Organizations Risk Management: An Overview of Risk Management, Risk Identification, Risk Assessment, Risk Control Strategies, Selecting a Risk Control						

Strategy.		
Unit:3	Planning for Security	11-- hours
Information Security Policy, Standards and Practices, The Information Security Blueprint, Security Education, Training and Awareness Program, Continuity Strategies.		
Unit:4	Security Technology	11-- hours
Firewalls and VPNs- Intrusion Detection and Prevention Systems, Honeypots, Honeynets and padded cell systems -Scanning and Analysis Tools- bio metric access control.		
Unit:5	Cryptography	12-- hours
Cipher Methods, Cryptographic Algorithms, Cryptographic Tools, Protocols for secured communication-Attacks on Cryptosystems.		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60-- hours
Text Books		
1	Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, 4th Edition, Course Technology, Cengage Learning.	
2	William Stallings, Cryptography and Network Security, Pearson Education, 2000.	
Reference Books		
1	Nina Godbole, Information Systems Security, Wiley-2009	
2	Micki Krause, Harold F. Tipton, “Handbook of Information Security Management”, Vol 1-3 CRC Press LLC, 2008.	
3	Stuart McClure, Joel Scrambray, George Kurtz, “Hacking Exposed”, Tata McGraw- Hill,	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.coursera.org/learn/information-security-data	
2	https://nptel.ac.in/courses	
Course Designed By:Dr. K. Geetha		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	S	S	S
CO2	S	S	M	M	M	S	L	S	S	S
CO3	S	S	M	S	M	M	S	S	S	M
CO4	S	L	M	M	M	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	S	M
CO6	S	M	S	M	M	S	L	S	S	M

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

Course Code	20CS2C3	INTERNET OF THINGS	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Basic knowledge on Sensors, Network Reference Model	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To understand the fundamentals of Internet of Things						
2. To learn about the basics of IoT protocols						
3. To apply the concept of Internet of Things in the real world scenario.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basics of IoT and its characteristics				K1/K2	
2	Analyze the building blocks of IoT from physical and logical context				K2/K4	
3	Apply the functionality of various architectures and protocols of IoT				K2/K3	
4	Analyze the importance of Web of Things and Cloud of Things				K1/K4	
5	Analyze the applications of IoT in various domains and analyze thereal-world design constraints				K3/K4/K5	
6	Create a low-cost embedded system				K2/K3/K5/K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1		Wireless Networks Introduction			12hours	
Fundamentals of IoT and Design Methodology						
Introduction to Internet of Things: Definition & Characteristics of IoT-Physical Design of IoT- Logical Design of IoT-IoT Enabling Technologies- IoT Levels & Deployment Templates- Four Pillars of IoT. IoT and M2M: Introduction- M2M- Difference between IoT and M2M – SDN and NFV for IoT. IoT Platforms Design Methodology: Introduction- IoT Design Methodology.						
Unit:2		Architecture			12 hours	
IoT Architecture: M2M High-Level ETSI Architecture - OGC Architecture - IoT ReferenceModel - Domain Model - Information Model - Functional Model - Communication Model –IoTReference Architecture.						
Unit:3		Internet of Things Protocols and Standards			1 2 hours	
Introduction- IoT Ecosystem -IoT Data Link Protocol-Network Layer Routing Protocols- Network Layer Encapsulation Protocols- Session Layer Protocols- Transport Layer Protocols- IoT Management Protocol- Security in IoT Protocols-IoT Challenges						
Unit:4		Web of Things and Cloud of Things			1 2 hours	

Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards– Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

Unit:5	Industry 4.0	10hours
Introduction- IIoT, Industry 4.0 – IIoT architecture – IIoT Connectivity- Standardization of IIoT - Opportunities – Challenges.		
Unit:6	Applications and Case Studies	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours

TextBooks

1	ArshdeepBahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014.

Reference Books

1	HwaiyuGeng, “Internet of Things and Data Analytics Handbook”, John Wiley & Sons, 2017.
2	Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2015.
3	HYPERLINK "https://www.wiley.com/en-us/search?pq=%7C relevance%7C author%3A Qusay+F.+Hassan" Qusay F. Hassan. (2018). Internet of Things A to Z: Technologies and Applications. Wiley-IEEE Press.
4	Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012

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

1	http://nptel.ac.in/courses/106105166/
2	https://www.edx.org/course/iot-networks-protocols-curtin-x-iot3x
3	https://www.coursera.org/learn/iot
4	EmilianoSisinn, AbusayeedSaifullah, Song Han, Ulf Jennehag, Mikael Gidlund, Industrial Internet of Things: Challenges, Opportunities, and Directions, IEEE Transactions on Industrial Informatics, April 2018

Course Designed By: Dr.P.B.Pankajavalli

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	M	L	L	L	L	L	L	L
CO2	M	L	L	M	L	M	L	L	L	M
CO3	L	M	L	L	S	M	M	L	L	L
CO4	M	L	M	M	L	M	L	M	L	M
CO5	M	L	M	S	L	L	L	L	L	S
CO6	L	M	S	M	L	L	L	L	L	L

- Unit 1 – Chapter 1,3,5 ArshdeepBahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
- <http://speed.cis.nctu.edu.tw/~ydlin/course/cn/iot/iot.html> -ppt
- <https://books.google.co.in/books?id=JPKGBAAQBAJ&printsec=frontcover#v=onepage&q&f=true> Book link
-
- Unit I – Chapte 3 - Four Pillars of IoT
- Unit IV - Chapter 6,7,8,9 ➔ Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2015.
- UNIT II –IIIUNIT IOT.pdf
- Unit 3 – Chapter 13 - HwaiyuGeng, “Internet of Things and Data Analytics Handbook”, John Wiley & Sons, 2017.
- Unit V - EmilianoSisinn, AbusayeedSaifullah, Song Han, Ulf Jennehag, Mikael Gidlund, Industrial Internet of Things: Challenges, Opportunities, and Directions, IEEE Transactions on Industrial Informatics, April 2018

Course code	20CS2C4	DATA MINING TECHNIQUES AND TOOLS	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Fundamentals of Database management	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To understand the concepts of data mining, KDD process, issues and applications.						
2. To know the working of different data mining techniques and its uses.						
3. To learn the usage of data mining tools WEKA and RapidMiner.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand about data mining basics, issues and the working principle of classification technique.				K2	
2	Analyze the working of different clustering algorithms.				K2/K3/K4	
3	Understand the basic concepts of Association Rule Mining and evaluate the working of various Association Rule Mining algorithms				K2/K3/K4	
4	Understand the difference between Web mining, Text mining and Sequence mining.				K2/K3/K4	
5	Understand and analyze the working of WEKA and RapidMiner tools.				K2/K3/K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1		Data Mining			10 hours	
Introduction – Definitions - KDD vs. Data mining - DM techniques – Issues and Challenges in Data Mining – Data mining application areas. Classification Technique: Introduction – Decision Trees: Tree Construction Principle - Decision Tree construction Algorithm –CART – ID3 – Rainforest –CLOUDS.						
Unit:2		Clustering Techniques			12 hours	
Clustering paradigms – Partitioning algorithm - K-Means – K-Medoid algorithms – CLARA –						

Hierarchical Clustering - DBSCAN – BIRCH – Categorical clustering algorithms – STIRR - Other techniques. Introduction to neural network - learning in NN – Unsupervised Learning - Genetic algorithm.		
Unit:3	Association Rules	15 hours
Concepts - Methods to discover association rules - A priori algorithm – Partition algorithm - Dynamic Item set Counting algorithm - FP-tree growth algorithm - Incremental algorithm - Generalized association rule.		
Unit:4	Web mining	10 hours
Basic concepts – Web content mining – Web structure mining – Web usage mining – Text mining: Text clustering - Sequence mining: The GSP algorithm – SPADE.		
Unit:5	Tools	11 hours
Need for data mining tools - Introduction to WEKA – The Explorer – The Experimenter – Classification – Regression – Clustering- Nearest neighbor - Introduction to Rapid Miner – Import data – Export data - Modeling: Classification – Clustering - Association – Visualization.		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Books		
1	Arun K. Pujari, Data Mining Techniques, Third Edition, Universities Press (India) Limited. Hyderabad, 2009	
2	Margaret H. Dunham, Data Mining Introductory and Advanced Topics, Pearson Education 2004.	
3	Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques. Elsevier, 2011.	
Reference Books		
1	FareedAkthar, Caroline Hahne, “RapidMiner 5 Operator Reference”, Rapid-I GmbH, 2012.	
2	Pieter Adriaans, DolfZantinge, Data Mining, Addison Wesley, 2008	
3	Jaiwei Han and MichelineKamber, Data Mining Concepts and Techniques, MorganKaufmann Publishers, 2011, 3rd Edition.	
4	Dr. Matthew A. North, “Data Mining for the Masses”, A Global Text Project Book, 18 August 2012	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd2_cec20_cs12/preview	
2	http://ucanalytics.com/blogs/learn-r-12-books-and-online-resources/	
3	https://www.futurelearn.com/courses/data-mining-with-weka	
4	https://docs.rapidminer.com/downloads/RapidMiner-v6-user-manual.pdf	
5	http://ijsetr.org/wp-content/uploads/2015/04/IJSETR-VOL-4-ISSUE-4-816-820.pdf	
6	https://www.ijcaite.com/IJCAIT/21/213.pdf	
Course Designed By: Dr. S. Vijayarani		

Mapping with programme outcomes:

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

S- Strong; M-Medium; L-Low

Course code	20CS2C5	DATABASE ADMINISTRATION AND MANAGEMENT	L	T	P	C
Core/Elective/Supportive	CORE		2	0	4	4
Pre-requisite	Knowledge in the fundamentals of database management system		Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. Inculcate the knowledge on the fundamentals of database administration and management						
2. Understand and effectively demonstrate the key concepts of advanced SQL						
3. Know the concepts of transaction processing, distributed DBMS, business intelligence and data warehouse.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Remember and Understand the design and creation of tables in databases				K1/K2	
2	Remember and Apply advanced SQL, sub queries				K1/K3	
3	Remember and Analyze the requirements of transaction processing, recovery and data security				K1/K4	
4	Analyze and Evaluate the advantages, disadvantages, design and development of distributed database management systems				K4/K5	
5	Understand and Apply business intelligence and data warehouses, security and authorization.				K2/K3	
6	Apply Artificial Intelligence and create databases				K3/K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1						
INTRODUCTION			11hours			
Introduction: Purpose of Database Systems -View of Data -Database Languages -Data Storage and Querying-Transaction Management –Storage Management –Data Mining and Information Retrieval -Speciality Databases -Database Users and Administrators–Relational Databases: Introduction to the Relational Model -Structure of Relational Databases-Database Schema -Keys-Schema Diagrams						

Relational Query Languages -Relational Operations		
Unit:2	ADVANCED SQL	11hours
Advanced SQL: Constraints- SQL CREATE INDEX- SQL functions-The GROUP BY statement-The HAVING clause- SQL special functions- SQL alias- SQL join – Sub queries- Recursive queries-Data control language-Views and assertion- PL/SQL- a basic introduction-Triggers- Event condition action model-Functions and procedures-Embedded SQL and dynamic SQL- The java way to access RDBMS: JDBC- SQLJ		
Unit:3	TRANSACTION PROCESSING AND SECURITY	12hours
Advanced transaction processing and recovery: Defining a transaction in DBMS-Defining a concurrent transaction in DBMS- Serializability and Recoverability- Enhanced lock-based and time-stamp based concepts-Multiple granularity-Multi version schemes-optimistic concurrency control techniques-Deadlock handling-Recovery in DBMS-write Ahead logging protocol-Advanced recovery techniques-Use of SQL in recovery -RAID. Data security: Data security issues-Discretionary access control- Mandatory access control- Role based access control- SQL injection-Statistical databases- Introduction to flow control		
Unit:4	DISTRIBUTED DBMS	12hours
Distributed Database Management Systems: The Evolution of Distributed Database Management Systems -DDBMS Advantages and Disadvantages -Distributed Processing and Databases - Characteristics of Distributed DBMS -DDBMS Components -Levels of Data and Process Distribution -Distribution Transparency -Transaction Transparency-Distributed Database Design - Client/Server vs. DDBMS		
Unit:5	BUSINESS INTELLIGENCE AND DATA WAREHOUSE	12hours
Business Intelligence and Data Warehouses: The Need for Data Analysis -Business Intelligence and Architecture -Data Warehouse-OLAP -Star Schemas -Implementing a Data Warehouse -SQL Extensions for OLAP. Database Connectivity - Internet Databases. Security and authorization: Access control- Discretionary access control-Mandatory access control – security for internet applications-Issues related to security-case study		
Unit:6	OPERATIONAL DATABASE MANAGEMENT SYSTEM	02hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60hours
Text Book(s)		
1	RiniChakrabarti, ShilbadraDasgupta, Subhash K. Shinde, Advanced Database Management System”, KLSI, Dreamtech press, 2014.	
2	Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, McGraw Hill, Third Edition 2004.	
Reference Book(s)		
1	Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Fifth Edition, McGraw Hill, 2006.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		

1	https://swayam.gov.in/nd2_cec19_cs05/preview
2	https://www.featuredcustomers.com
3	https://www.transparencymarketresearch.com
4	https://www.maximizemarketresearch.com
Course Designed By: Dr. D.Ramyachitra	

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	L	M	M	L	L	L
CO2	M	S	M	M	M	M	L	M	L	M
CO3	M	L	L	M	M	L	M	L	L	L
CO4	M	L	M	M	M	M	L	L	M	L
CO5	S	M	L	S	M	L	L	M	L	M
CO6	S	L	L	S	L	M	M	M	M	L

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

Course code	20CS3C1	VISUAL PROGRAMMING	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basics of VB language and ASP	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to: 1. Provide in depth knowledge on VB.NET and ASP.NET to students and making them to develop dynamic web applications, websites using VB and C# object oriented way of programming an elegant way using window controls and web controls. 2. Train the students to enrich their knowledge in ASP.NET user controls, custom controls, data management with ADO.NET. 3. Provide knowledge in developing LINQ related applications and also in developing AJAX application and ASP.NET web services.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand about .NET framework, .NET features, common language runtime, .NET framework libraries and the Visual Studio Integrated Development Environment and Programming in C#					K1/K2
2	Write a console application using classes and objects, constructor, overloading, inheritance, polymorphism, interface, array, exceptions, delegates and events in C# and VB Scripts. Create window applications using window controls, Menus and graphics in VB and C#.					K2/K3/K6
3	Understand the ASP.NET features, ASP.NET page directives and, To build the application using Web server Controls, Validation Server Controls, Rich Web Controls, Custom Controls, Collections and Lists.					K1/K2
4	Understand ADO.NET and to develop the application using ADO.NET with VB.NET and ASP.NET, and also LINQ queries.					K2/K3/K4 /K6

5	Building ASP.NET 3.5 Enterprise Applications using ASP.NET Ajax applications and ASP.NET web services.	K2/K3/K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		
Unit:1	Introduction to .NET and C#	10 hours
The .NET Framework – Benefits of .NET - Common Language Runtime – Features of CLR - Compilation and MSIL – The .NET Framework libraries – The Visual Studio Integrated Development Environment – Introduction to C#: Basics of C# - Data types - variable declarations – Implicit & Explicit type casting – Branching and Looping.		
Unit:2	Introduction to VB.NET and Object Oriented Concepts in C#.NET & VB.NET	13 hours
Introduction to VB.NET – VB.NET fundamentals – Branching and Looping Statements - Object Oriented Programming in C#.NET and VB.NET: Objects and Functions – Encapsulation – Inheritance - Constructors – Overloading - Inheritance and Polymorphism – Exception - Delegates and Events Arrays – Strings – Exceptions.		
Unit:3	Building Windows Applications and Deployments	10 hours
Building Windows Applications – Creating a Windows Applications using window controls - Windows Forms, Text Boxes, Rich Text boxes, Labels, and link labels – Buttons, Check boxes, Radio buttons, Panels and Group Boxes, List Boxes, Checked List boxes, Combo boxes and Picture boxes, Scroll bars – Calendar control, Timer control – Handling Menus – Dialog boxes – Deploying an Application – Graphics.		
Unit:4	Basics of ASP.NET, Types of Controls and Collections	12 hours
ASP.NET Basics: Features of ASP.NET – ASP.NET page directives - Building Forms with Web server Controls – Validation Server Controls - Rich Web Controls - Custom Controls – Collections and Lists.		
Unit:5	ADO.NET and Web Services	13-- hours
Data Management with ADO.NET - Introducing ADO.NET - ADO.NET features - Using SQL Server with VB.NET – Using SQL Server with ASP.NET – LINQ queries – Building ASP.NET 3.5 Enterprise Applications: Developing ASP.NET Ajax applications – ASP.NET web services.		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Book(s)		
1	Bill Evjen, Scott Hanselman, Devin Rader, Professional ASP.NET 4 in C# and VB I Edition, 2010, Wiley Publishing, Inc.	
2	Steven Holzner, Visual Basic.NET Programming Black Book, 2005 Edition, Paraglyph press USA&Dreamtech Press, India.	
3	KoGENT Solutions Inc., ASP.NET 3.5 (Covers C# and VB 2008 codes) Black Book, Platinum Edition, Dreamtech press, 2010	
4	Jesse Liberty, Programming C#, Fourth Edition, Building .NET Applications with C#, O'Reilly Media publication, 2005	

Reference Books	
1	Jonas Fagerberg, ASP.NET Core 1.1 Web API For Beginners: How To Build a Web API, The Tactical Guide Book, CSharpSchool.com, 2017.
2	Jesse Liberty, Programming Visual Basic.NET 2003, Second Edition, O Reilly, Shroff Publishers and Distributors Pvt. Ltd. .
3	Andrew Troelsen, „C# and the .NET Platform“, A Press, 2001.
4	Bill Evjen, JasonBeres, et al. Visual Basic.NET Programming Bible, 2002 Edition, IDG books India (p) Ltd.
5	Mridula Parihar et al., ASP.NET Bible, 2002 Edition, Hungry Minds Inc, New York, USA.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.w3schools.com/asp/
2	https://www.tutorialspoint.com/vb.net
3	https://www.tutorialspoint.com/ASP.net
Course Designed By: Dr. R. Porkodi	

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

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

Course code	20CS3C2	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Fundamentals of Software Project Management	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide in depth knowledge about the basic concepts of software project management, project planning and Step Wise framework in project planning						
2. To discuss the Project planning, cost benefit						
3. To inculcate continual training and learning to improve group working						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the fundamentals of Software Project Management, Software Project Versus Other Project, Requirement Specification, Information and Control in Organization. Understand the Introduction to step wise Project Planning, Select, Identify Scope and Objectives, Identify Project Infrastructure, Analyse Project Characteristics, Products and Activities.Understand the estimateEffort for each					K2/ K4

	Activity , Identify Activity Risks , Allocate Resources , Review / Publicize Plan , Execute Plan and Lower Levels of Planning.	
2	Understand the Project Evaluation: Introduction , Strategic Assessment, Technical Assessment , Cost Benefit Analysis , Cash Flow Forecasting , Cost Benefit Evaluation Techniques. Understand the Risk Evaluation , Selection of an Appropriate Project Approach, Choosing Technologies, Choice of Process Models , Structured Methods , Rapid Application Development , Waterfall Model, V-Process Model ,Spiral Model. Understand the Software Prototyping , Ways of Categorizing Prototypes, Tools , Incremental Delivery, Selection Process Model.	K2/ K4
3	Understand the fundamentals of Software Effort Estimation : Introduction, Problems with Over and Under Estimates, Basis for Software Estimating, Software Effort Estimation Technique. Understand the fundamental of Albrecht Function Point Analysis, Function Points, Object Points, Procedural Code Oriented Approach. Understand the various types of passes like Forward Pass , Backward Pass, Identifying the Critical Path , Activity Float ,Shortening Project Duration , Identifying Critical Activities, Precedence Networks.	K2/ K4
4	Understand the introduction of Risk Management : Nature of Risk Managing Identification, Analysis, Reducing, Evaluating Z values, Resource Allocation, Nature of Resources. Understand the Requirements of Scheduling, Critical Paths, Counting the Cost, Resource Schedule, Cost Schedule, Scheduling Sequence, Monitoring and Control, Creating the Frame Work. Understand the Collecting the Data, Visualizing the Progress, Cost Monitoring, Prioritizing Monitoring, Change Control.	K2/ K4
5	Understanding the various types of contracts, Managing Contracts, Stages in Contract Placement ,Terms of Contract, Contract Management, Acceptance, Managing People and Organizing Teams. Understand the Organizational Behavior Background, Selecting the Right Person for the Job, Instruction in the Best Methods, Motivation, Decision Making, Leadership, Organizational Structures, Software Quality, Importance, Practical Measures, Product.	K2/ K4

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

Unit:1	Introduction	10 hours
Software Project Management -Software Project Versus Other Project –Requirement Specification –Information and Control in Organization –Introduction to step wise Project Planning –Select –Identify Scope and Objectives -Identify Project Infrastructure –AnalyseProject Characteristics –Products and Activities –Estimate Effort for each Activity –Identify Activity Risks –Allocate Resources -Review / Publicize Plan –Execute Plan and Lower Levels of Planning.		
Unit:2	Project Evaluation	12 hours
Introduction –Strategic Assessment –Technical Assessment –Cost Benefit Analysis –Cash Flow Forecasting –Cost Benefit Evaluation Techniques –Risk Evaluation –Selection of an Appropriate Project Approach –Choosing Technologies –Choice of Process Models –Structured Methods –Rapid Application Development –Waterfall Model –V-Process Model –Spiral Model –Software Prototyping –Ways of Categorizing Prototypes –Tools –Incremental Delivery –Selection Process Model		

Unit:3	Software Effort Estimation	15 hours
Introduction –Problem s with Over and Under Estimates –Basis for Software Estimating – Software Effort Estimation Technique –Albrecht Function Point Analysis –Function Points – Object Points –Procedural Code Oriented Approach –COCOMO –ActivityPlanning –Project Schedules -Projects and activities –Sequencing and Scheduling Activities –Network Planning Models –Formulating a Network Planning –Adding Time Dimension –Forward Pass – Backward Pas s –Identifying the Critical Path –Activity Float -Shortening Project Duration – Identifying Critical Activities –Precedence Networks.		
Unit:4	Risk Management	10 hours
Introduction –Nature of Risk Man aging Identification –Analysis –Reducing –Evaluating –Z values –Resource Allocation –Nature of Resources –Requirements –Scheduling –Critical Paths – Counting the Cost –Resource Schedule –CostSchedule –Scheduling Sequence –Monitoring and Control –Creating the Frame Work -Collecting the Data –Visualizing the Progress –Cost Monitoring –Prioritizing Monitoring –Change Control		
Unit:5	Managing Contracts	11 hours
Introduction –Types of Contract –Stages in Contract Placement –Terms of Contract –Contract Management –Acceptance –Managing People and Organizing Teams –Organizational Behavior Background –Selecting the Right Person for the Job –Instruction in the Best Methods – Motivation –Decision Making –Leadership –Organizational Structures –Software Quality – Importance –Practical Measures –Product.		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Books		
1	Bob Hughes (Author), Mike Cotterell (Author), Rajib Mall (Author)- 2 October 2017	
2	Software Engineering Project Management, Richard Thayers 2nd Edition 2014	
3	Effective Software Project Management, Robert K. Wysocki - 2010	
Reference Books		
1	Walker Royce, “Software Project Management , Addition Wesley.	
2	DerrellInce, H. Sharp and M. Woodman, “Introduction to Software Project Management and Quality Assurance , Tata McGraw Hill, 1995	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/106/105/106105218/	
2	https://swayam.gov.in/nd1_noc19_cs70/preview	
3	https://freevidelectures.com/course/4071/nptel-software-project-management	
4	https://www.nptelvideos.com/video.php?id=918	
5	https://www.classcentral.com/course/swayam-software-project-management-14294	
6	https://www.w3schools.in/sdlc-tutorial/software-development-life-cycle-sdlc/	
Course Designed By: Dr. D. NAPOLEON		

Mapping with programme outcomes:

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

S- Strong; M-Medium; L-Low

Course code	20CS3C3	CLOUD COMPUTING	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Basic knowledge on software system specifically on operating system	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1.Understand the different concepts of cloud computing and its services						
2.Store and retrieve the data from cloud and can provide the security to the data in cloud						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Articulate the main concepts, key technologies of cloud computing in terms of strengths, limitations and applications.			K1		
2	Categorize the architecture and infrastructure of cloud computing such as IaaS and SaaS			K1/K3		
3	Explain the concept of virtual machines and virtualization			K3/K4		
4	Apply suitable storage algorithms in cloud computing			K3		
5	Be expose in broad approaches of migrating into a cloud and mobile cloud computing			K2/K3/K4		
6	Describe about the data security concepts in cloud computing			K2/K6		
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1						
Introduction			12hours			
Introduction: Cloud Computing Basics: Cloud Computing Overview - Applications of cloud computing - Intranets and the cloud – First movers in the cloud - Benefits - limitations of cloud computing – Security Concerns – Cloud Computing Services – Salesforce.com						
Unit:2						
Cloud Computing Technology			12hours			
Hardware and Infrastructure – Clients – Security – Network – Services - Cloud Storage – Standards – Cloud Computing at work: Software as a Service – Software Plus Services – Developing Applications						
Unit:3						
Virtual Machines and Virtualization			12hours			
Introduction - Understanding Virtualization - History of Virtualization – Leveraging Blade Servers – Server Virtualization – Desktop Virtualization – Virtual Networks – Data Storage Virtualization. Data Storage in Cloud: Evolution of Network Storage – Cloud based data Storage – Advantages and disadvantages of Cloud based data storage- Cloud based Backup systems - File Systems – Cloud based Block Storage						
Unit:4						
Migrating into a Cloud			12hours			
Introduction – Broad approaches of Migrating into cloud – The Seven Step Models of Migrating into a Cloud. Mobile Cloud Computing: Evolution of Mobile Computing – Mobile Cloud EcoSystem – Mobile Players						
Unit:5						
Data security in cloud			10hours			

Introduction – Current state of data security – Homo sapiens and Digital Information – Cloud Computing and Data security Risk – Cloud Computing and Identity – The Cloud, Digital Identity and Data Security- Content Level Security- Pros and Cons		
Unit:6	Introduction to Industry 5.0	02hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Books		
1	Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, “ Cloud Computing: A Practical Approach”, McGraw Hill	
2	Kris Jamsa, “ Cloud Computing” Jones and Barlett Student Edition 2014	
Reference Books		
1	RajkumarByya, James Broberg, AndrzejGoscinski, “ Cloud Computing Principles and Paradigms”, Wiley & sons	
2	E-Resources	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc20_cs55/	
2	https://nptel.ac.in/courses/106/105/106105223/	
Course Designed By: Dr.E.Chandra		

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	L	L	M	L	L	S	S
CO2	M	M	M	M	M	M	L	S	S	S
CO3	S	S	M	M	M	M	M	S	M	L
CO4	S	S	S	S	L	S	M	S	M	M
CO5	S	S	M	S	L	S	M	M	S	S
CO6	S	S	L	S	S	S	S	M	S	M

S- Strong; M-Medium; L-Low

Course code	20CS3C4	BIG DATA ANALYTICS	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Fundamentals of Database management and Data Mining	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide in depth knowledge about the basic concepts of Big Data, characteristics and industry examples.						
2. To discuss the Hadoop framework, HDFS and MapReduce.						
3. To inculcate HBase, Cassandra, HiveQL, Pig, and Neo4j data models.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand about basics of Big Data, Technologies and Applications in various domains.				K2	
2	Understand the foundations of Hadoop and Hadoop Distributed File System. Design of HDFS and file-based data structures.				K2/K3/K4	
3	Analyze the working of Map Reduce and YARN for job scheduling.				K2/K3/K4	
4	Evaluate the need and fundamentals of HBase. Apply the Cassandra data model for different applications. Understand the basic commands in HiveQL, Pig and Pig Latin.				K2/K3/K4	
5	Analyze the basic concepts and need for Graph databases, create databases and retrieve records using Neo4j. Understand the data visualization and its need.				K2/K3/K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1						
Introduction to Big Data			10 hours			
Introduction: What is big data – why big data – convergence of key trends - unstructured data – industry examples of big data – Web analytics - big data and marketing – fraud and big data - risk and big data – credit risk management – big data and algorithmic trading - big data and healthcare – big data in medicine – advertising and big data – big data technologies - cloud and big data – mobile business intelligence – crowd sourcing analytics.						
Unit:2						
Hadoop			12 hours			
History of Hadoop - The Hadoop Distributed File System – components of Hadoop - Analyzing the Data with Hadoop - Design of HDFS – HDFS concepts - Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures.						
MapReduce			15 hours			
MapReduce: MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.						
Hadoop Eco System			10 hours			
HBase – data model and implementations – HBase clients – HBase examples. Cassandra – Cassandra data model – Cassandra examples – Cassandra clients – Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries-case study.						
Graph Databases			11 hours			

Introduction - Neo4J - Key concept and characteristics -Modeling data for neo4j - Importing data into neo4j - visualizations - neo4j - Cypher Query Language –data visualization.		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Books		
1	Tom White, “Hadoop: The Definitive Guide”, Fourth Edition, O’Reilly Publishers, 2012.	
2	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.	
3	Rik Van Bruggen, “Learning Neo4j”, Second Edition, PacktPublishers, 2014.	
Reference Books		
1	Andreas Francois Vermeulen, Ankurgupta, Cindy Gross, David Kjerrumgaard and Scott Shaw, “Practical Hive: A Guide to Hadoop’s Data Warehouse System”, Apress Media publishers, 2016	
2	Eric Lubow and Russell Baradberry, Practical Cassandra: A Developer’s Approach, Addison Wesley publishers, 2014.	
3	Dirk deRoos, Paul Zikopoulos, Bruce Brown, Roman B. Melnyk,RafaelCoss, “Hadoop For Dummies”, John Wiley & Sons publishers, 2014	
4	Hunger, Michael, and Oliver Gierke. Good Relationships: The Spring Data Neo4j Guide Book. C4Media, 2012.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/106/104/106104189/	
2	http://statweb.stanford.edu/~tibs/ElemStatLearn/	
3	https://www.edureka.co/blog/big-data-tutorial	
4	https://www.coursera.org/learn/big-data-introduction	
5	https://cognitiveclass.ai/courses/what-is-big-data	
6	https://www.tutorialspoint.com/hbase/index.htm	
7	https://www.guru99.com/hive-query-language-built-operators-functions.html	
Course Designed By: Dr. S. Vijayarani		

Mapping with programme outcomes:

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

S- Strong; M-Medium; L-Low

Course Code	20CS3C5	WIRELESS NETWORKS	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		To introduce the students to state of the art wireless network conventions and models	Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to: 1. Learn state-of-the-art wireless technologies and the fundamental principles of electromagnetic wave propagation, and the parameters that dictate its performance. 2. Acquire knowledge in routing protocols for wireless networks. 3. Explore and understand the basic network performance metrics for evaluating and maintaining Quality of Service (QoS) in broadband mobile and wireless communication systems. 4. Comprehend the time synchronization, localization, energy management in wireless sensor network						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basic WSN technology and supporting protocols, with emphasis place on standardization basic sensor systems and provide a survey of sensor technology.			K1/K2		
2	Understand the medium access control protocols and address physical layer issues.			K2/K4		
3	Evaluate key routing protocols for sensor networks and main design issues.			K2/K5		
4	Analyze transport layer protocols for sensor networks, and design requirements.			K2/K3/K4		
5	Understand the Sensor management, sensor network middleware, operating systems.			K2/K3/K4		
6	Create and analyze low-power devices equipped with sensing, computation, and wireless communication capabilities.			K4/K6		
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1						
Unit:1		Wireless Networks Introduction	10hours			
Evolution of wireless networks – Challenges - Transmission fundamentals: Analog and digital data transmission - Transmission media - Modulation techniques for wireless systems - Multiple access for wireless systems - Performance increasing techniques for wireless networks.						
Unit:2						
Unit:2		Wireless LAN	12 hours			
Introduction to Wireless LANs – WLAN Equipment, Topologies, Technologies, IEEE 802.11 WLAN – Architecture and Services - Physical Layer - MAC Sub Layer –MAC Management Sub Layer, Other IEEE 802.11 Standards.						
Unit:3						
Unit:3		Wireless Personal Area Networks	1 2 hours			
Introduction – Bluetooth: Architecture - Protocol Stack - Physical Connection – Mac mechanism – Frame format – Connection management –Low Rate and High Rate WPAN, ZigBee Technology IEEE 802.15.4: Components – Network topologies – PHY – MAC.						
Unit:4		Ad-hoc Wireless Networks	12hours			

Introduction- Characteristics of Adhoc Networks - Classifications of MAC Protocols: Connection Based protocols, Reservation Mechanism - Table driven Routing protocols: DSDV, WRP - On Demand routing protocols: DSR,AODV,TORA –Routing Protocol with Efficient Flooding Mechanism: OLSR - Hierarchical routing protocols – CBRP, FSR.		
Unit:5	Wireless Sensor Networks	12hours
Introduction - Challenges for wireless sensor networks - Comparison of sensor network with ad-hoc network - Single node architecture: Hardware components - Energy consumption of sensor nodes - Network architecture: Sensor network scenarios - Design principles – Operating systems.		
Unit:6	Case Studies	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60hours
Text Books		
1	Nicolopolitidis P, “Wireless Networks”, John Wiley and Sons, New York, 2010.	
2	Vijay K Garg, Wireless Communication and Networking, Morgan Kaufmann Publishers 2010.	
3	Siva Ram Murthy C.,Manoj B S, “Ad Hoc Wireless Networks: Architectures and Protocols”, Prentice Hall, 2012.	
Reference Books		
1	Holger Karl and Andreas Willig, “Protocol and Architecture for Wireless Sensor Networks”, John Willey Publication, 2011.	
2	KavehPahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2013.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.te.com/usa-en/industries/sensor-solutions/insights/sensors-sleep-apnea-white-paper.html	
2	https://www.bluetooth.com/blog/smart-building-use-cases/	
3	https://wballiance.com/wp-content/uploads/2019/03/Case-Study_VAST-Networks-Mobile-Data-Offload.pdf	
4	https://www.postscapes.com/agtech/#case-studies	
Course Designed By: Dr.P.B.Pankajavalli		

Mapping with programme outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	S	L	L	M	M	L
CO2	S	L	L	L	S	L	L	L	L	M
CO3	S	M	L	L	S	M	L	L	M	M
CO4	S	M	S	L	M	L	M	M	M	L
CO5	S	S	M	L	M	L	M	L	M	S
CO6	M	M	L	L	L	L	L	L	L	L

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

ELECTIVE PAPERS

Course code	20CS1E1	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	4	0	4
Pre-requisite		Higher secondary level of mathematics and statistics	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. Introduce the basic mathematical terminologies required to understand the various designing concepts, storage methods and to improve the skill of logical thinking for solving different kinds of problems.						
2. Give exposure in matrices, theory and applications of Set theory, probability, and Mathematical Logic. Automata theory helps the learner to use it in practical applications of computer science.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand Matrix operations, determinant of a matrix, its properties and where it can be incorporated in computer applications				K2/K3/K4	
2	To introduce the basic of theory of sets, functions and relations and its applications				K2/K3/K4	
3	Understand and apply experiments, events, space; to understand Bayse;sThorem				K2/K3/K4	
4	Understand FA, NFA,DFA, Conversion of NFA to DFA, Derivation trees and it applications				K2/K3/K4	
5	Understand mathematical Logic to translate natural language sentences into symbolic form, construction of truth table and verification of tautology or contradiction				K2/K3/K4	
6	Understand Numerical Methods and toderive appropriate numerical methods to solve algebraic and transcendental equations				K2/K3/K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1						
Matrices, Determinants, Set Theory and Relations & Functions			12 hours			
Matrices: Types of Matrices - Matrix Operations - Inverse of a Matrix - Properties of Determinants - Eigen Values - Cayley-Hamilton Theorem. Set Theory: Basic Set Operations - Relations and Functions – Relation Matrices - Principle of Mathematical Induction.						
Unit:2						
Introduction to Probability			12 hours			
Sample Space and Events - Axioms of Probability - Conditional Probability – Independence of Events - Bayes Theorem. Regression and Correlation : Introduction – Linear Regression – Method of Least Squares – Normal Regression Analysis – Normal Correlation Analysis.						
Unit:3						
Grammars and Languages			11 hours			
Context Free Grammars – Introduction – Context Free Grammars – Derivation Trees. Finite Automata: Finite State Systems – Basic Definitions – Non Deterministic Finite Automata.						

Unit:4		Mathematical Logic	12 hours
Statements and Notations – Connectives – Consistency of Premises and Indirect Method of Proof – Automatic Theorem Proving.			
Unit:5		Numerical Methods	11 hours
Finding Roots : Bisection Method - Regula–Falsi Method - Newton–RaphsonMethod. Solution of Simultaneous Linear Equations: Gaussian Elimination - Gauss-Seidal Method. Numerical Integration: Trapezoidal Rule - Simpson s Rule.			
Unit:6		Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops			
		Total Lecture hours	60 hours
Text Books			
1	M. K. Venkataraman, “Engineering Mathematics, Volume II, National Publishing Company.		
2	John E. Freunds, Irwin Miller, Marylees Miller, “Mathematical Statistics, Pearson Education, Sixth Edition		
3	T.T. Soong,”Fundamentals of Probability and Statistics for Engineers”John Wiley & Sons Ltd.		
Reference Books			
1	Peter Linz, “An Introduction to Formal Languages and Automata, Jones & Bartlett Learning, Fifth Edition, 2011.		
2	Tremblay and Manohar, “Discrete Mathematical Structures with Applications to Computer Science , Tata McGraw-Hill.		
3	S.S. Sastry, “Introductory Methods of Numerical analysis, PHI Learning Private Limited, Fifth Edition, 2012		
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]			
1	https://www.math.hmc.edu/calculus/tutorials/matrixalgebra/		
2	https://www.tutorialspoint.com/automata_theory/index.htm		
Course Designed By: Dr. K. Geetha			

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	L	S	S	S	S	M
CO3	S	S	S	M	L	S	S	S	S	M
CO3	S	S	S	M	M	L	S	L	S	M
CO4	S	S	S	M	M	S	L	S	S	M
CO5	S	S	S	M	M	L	S	S	L	M
CO6	S	S	S	M	M	S	S	S	S	M

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

Course code	20CS1E2	PARALLEL PROCESSING	L	T	P	C
Core/Elective/Supportive	ELECTIVE		4	4	0	4
Pre-requisite	Fundamentals of processor and parallel processing		Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. Enable the students to be familiar with the definition and functions of parallel processing, Interrupt Mechanism and special hardware, principles of linear pipelining.						
2. Make students to understand the overview of the parallel processing, pipeline computing, application of parallel processing, memory and I/O system, hierarchical memory structure, virtual memory, pipeline computers, types of pipelining and its applications.						
3. Provide deep knowledge on vector processing, array processor, SIMD processor, types of SIMD computer organization, multiprocessor architecture, inter-process communication mechanism, time shared or common bus, parallel memory organization and classification of multi-processor operating system.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand about the concepts of parallel processing, parallel computers and pipeline computers and also to acquire adequate information about applications of parallel processor					K1/K2
2	Understand the concepts behind the memory management and I/O systems. And also to obtain the deep knowledge on interrupt mechanism and special hardware					K2
3	Understand the concepts of I/O processor and channel architecture. And also understand the concept of pipeline computers and its structures and provide the better understanding on designing either static or dynamic pipeline processor					K2/K4
4	Analyzing the concept of array processor, SIMD processor, and its interconnection networks and analyze the concept of static and dynamic networks construction and parallel algorithms for array processors					K2/K4
5	Understand the concept of multiprocessor architecture and functional structure of multiprocessor and analyzing the concepts of inter-process communication mechanism and classifying the multiprocessor operating system					K2/K3/ K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6– Create						
Unit:1 Introduction to parallel processing 11 hours						
Definition and functions of parallel processing- uniprocessor and parallel processing systems- parallel computers- pipeline computers- array processor- multiprocessor systems- performance of parallel computers- application of parallel processor..						
Unit:2 Memory and I/O systems 11 hours						
Memory system for parallel processor computers- hierarchical memory structures- virtual memory system- paged system- segmented system with paged segments- memory management policies- fixed partitioning and variable partitioning- cache memories and management- characteristics of cache memories- cache memory organization- input/output subsystem- characteristics of I/o subsystem- Interrupt Mechanism and special hardware- I/O processor and channel architecture.						
Unit:3 Linear Pipelining and Designing of Pipeline Processor 12 hours						

principles of linear pipelining- pipelined structures of a typical central processing unit- classification of pipeline processors- interleaved memory organization- S access memory organization- C access memory organization- C & S access memory organization- Static & dynamic pipelining- principles of designing static pipeline processors- Instruction prefetch and branch handling- data buffering and busing structures- Internal forwarding and register tagging- vector processing- requirements and characteristics of pipelined vector processing methods.		
Unit:4	Array Processors and Static and Dynamic Networks	13 hours
Single Instruction stream- Multiple data stream- SIMD processors- Types of SIMD computer organization- Array process or organization and associative processors- Array processor computer organization- SIMD interconnection networks- Static and Dynamic networks- Linear array, mesh, ring, star, tree, systolic, completely connected, chordal ring and cube networks- Parallel algorithms for array processors- SIMD matrix multiplication- Parallel sorting on array processors.		
Unit:5	Multiprocessor Architectures	11 hours
Functional structures of a multiprocessor system loosely and tightly coupled multiprocessor- Processor characteristics of multiprocessing- Inter processor communication mechanism- Instruction set- Interconnection networks- Time shared or common bus- cross bar switch and multi port memories and multistage networks for multiprocessor- Parallel memory organization- Interleaved memory configurations- classification of multiprocessor operating system.		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Book(s)		
1	Kai Hwang, Faye A. Briggs, Computer Architecture and Parallel Processing, Prentice Hall of India, 1985.	
Reference Books		
1	Kai Hwang, NareshJotwani, Advance Computer Architect: Parallelism, Scalability, Programmability, McGraw Hill, 1993.	
2	Rajaraman V, V. Siva Ram Murthy, Parallel Computers Architecture and Programming, PHI Learning Pvt. Ltd., Second Edition, 2016.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	shodhganga.inflibnet.ac.in/bitstream/10603/3398/7/07_chapter%201.pdf	
2	brahms.emu.edu.tr/rza/chapter1.pdf	
3	https://www.ida.liu.se/~TDTS08/lectures/12/lec8.pdf	
4	https://engineering.ucsb.edu/~hpscicom/p1.pdf	
5	https://engineering.ucsb.edu/~hpscicom/p1.pdf	
Course Designed By: Dr. R. Porkodi		

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

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

Course code	20CS1E3	WEB SERVICES	L	T	P	C
Core/Elective/Supportive		Elective	4	4	0	4
Pre-requisite		Fundamentals of mark-up language, basic knowledge on distributed services	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to: 1. Provide the strong foundation to students to be familiar with distributed services, XML and web Services 2. Cover the overview of the distributed computing, introduction to web services, technologies and concepts underlying web services, XML, SOAP, WSDL, UDDI specification, static and interactive aspects of system interface and its implementation, work flow, orchestration and refinement, transactions, security issues, the common attacks, security attacks facilitated within web services 3. Make the students to understand the quality of services, QOS metrics, mobile wireless service and building real world web service applications, Deployment of Web services and applications onto Tomcat application server.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand about the distributed computing, web services, technologies and concepts underlying web services and applications that consumes the web services				K1/K2	
2	Understand the basic concepts of XML, XML document (WSDL) and the concepts of XML protocol (SOAP), locating the remote web services and understand the concepts of UDDI and its specification				K2	
3	Understand the concepts of system interface and its workflow the common attacks and examining the concepts of architecture of system to meet the user requirements and analyze the concepts of mobile and wireless services				K2/K4	
4	Design and develop the real-world enterprise application using web services and also analyzing the steps necessary to build and deploy the web services				K2/K3/K4	
5	Applying the applications created based on the web services on different web servers like TOMCAT, axis SOAP server				K2/K3	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1						
Unit:1		Overview of Distributed Computing			10 hours	
Introduction to web services – Industry standards, Technologies and concepts underlying web services – their support to web services. Applications that consume web services.						

Unit:2	XML	13 hours
Its choice for web services – network protocols to back end databases- technologies – SOAP, WSDL – exchange of information between applications in distributed environment – locating remote web services – its access and usage. UDDI specification – an introduction.		
Unit:3	Web Services and Quality of Services	13 hours
Conversation – static and interactive aspects of system interface and its implementation, work flow – orchestration and refinement, transactions, security issues – the common attacks – security attacks facilitated within web services quality of services – Architecting of systems to meet users requirement with respect to latency, performance, reliability, QOS metrics, Mobile and wireless services – energy consumption, network bandwidth utilization, portals and services management.		
Unit:4	Building Real world Enterprise Applications using Web Services	11 hours
Sample source codes to develop web services – steps necessary to build and deploy web services and client applications to meet customer s requirement – Easier development, customization, maintenance, transactional requirements, seamless porting to multiple devices and platforms.		
Unit:5	Deployment of Web Services	11 hours
Deployment of Web services and applications onto Tomcat application server and axis SOAP server (both are free wares) – Web services platform as a set of enabling technologies for XML based distributed computing.		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Book(s)		
1	SandeepChatterjee, James Webber, Developing Enterprise Web Services: An Architects Guide, Prentice, 2004.	
2	Thomas Erl, “Service-Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005.	
Reference Books		
1	Newcomer, Lomow, “Understanding SOA with Web Services”, Pearson Education, 2005.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.tutorialspoint.com/webservices/webservices_tutorial.pdf	
2	https://www.w3.org/TR/ws-arch/wsa.pdf	
3	https://www.guru99.com/web-service-architecture.html	
Course Designed By: Dr. R. Porkodi		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	L	M	S	M	M	L	S
CO2	S	S	S	L	S	M	M	S	L	S

CO3	S	S	S	S	S	M	M	S	M	L
CO4	S	M	S	M	M	S	S	M	M	M
CO5	S	S	S	M	M	S	S	M	M	M

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

Course code	20CS2E1	OPERATION RESEARCH	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	4	0	4
Pre-requisite		To objective is to establish theories and algorithms translate to real life decision making problems.	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are: 1. To understand the key concepts of optimization which estimates the operations research problems then solved in defined steps by mathematical analysis. 2. To model and solve mathematical optimization problems that translates to real life decision making problems. 3. To understand the key concepts of optimization which estimates the operations research problems which are broken down into basic components						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand about the fundamentals of Operations Research,Linear Programming Problem.			K2/ K3		
2	Understand about simplex methods, Big-M method.			K2/ K3		
3	Understand about Transportation Problem and basic feasible solutions			K2/ K3		
4	Understand about Optimality test and Dual problem			K2/ K3		
5	Understand about Dual simplex Problem and Transportation algorithms.			K2/ K3		
6	Understand about Shortest route and Project network			K2/ K3		
7	Understand the concepts of Games Theory.			K2/ K3		
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1						
Unit:1		Introduction to Operations Research		17 hours		
Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem – Formulation of LPP, Graphical solution of LPP. Simplex Method, artificial variables, simplex Gauss-Jordan reduction process in simplex methods, Big-M method, two-phase method, degeneracy and unbound solutions.						
Unit:2						
Unit:2		Transportation Problem		11 hours		
Transportation Problem.-Formulation, solution, unbalanced Transportation problem. Finding basic						

feasible solutions – Northwest corner rule, least cost method and Vogel’s approximation method. Optimality test: the stepping stone method and MODI method, Minimization and Maximization problem.		
Unit:3	Dual Problem	12 hours
Relation between primal and dual problems, Dual simplex method, Sensitivity analysis Transportation algorithms –Assignment problem –Hungarian Method (Minimization and Maximization), Branch & Bound technique.		
Unit:4	Shortest Route	8 hours
Shortest route – minimal spanning tree - maximum flow models – project network- CPM and PERT network-critical path scheduling.		
Unit:5	Games Theory.	10 hours
Competitive games, rectangular game, saddle point, minimum (maximum) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.		
Unit:6	Case Study	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Books		
1	Michael Carter, Camille C. Price, Ghaith Rabadi, Operations Research: A Practical Introduction, CRC Press, 2019	
	Operations Research An Introduction to Research By Pearson Paperback – 31 August 2019	
2	Himanshu, Operations Research: An Introduction, ED Tech press, 2018	
Reference Books		
1	Hamdy A. Taha, Operations Research: An Introduction, 10th Edition, Pearson, 2017	
2	P. Mariappan, Operations Research: An Introduction, Dorling Kindersley (India), 2013	
3	H. A. Eiselt, Carl-Louis Sandblom, Operations Research: A Model-Based Approach, Springer, 2010.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc19_ma29/preview	
2	https://nptel.ac.in/courses/112/106/112106134/	
3	http://www.nptelvideos.in/2012/12/fundamentals-of-operations-research.html	
4	https://www.btechguru.com/courses--nptel--noc:introduction-to-operations-research-video-lecture.html	
Course Designed By: Dr. D.NAPOLEON		

Mapping with programme outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	M	S	S	M
CO2	S	S	M	S	M	S	M	M	S	S
CO3	S	S	S	S	L	M	S	M	M	M
CO4	S	S	L	L	M	L	S	M	L	M
CO5	S	S	S	L	S	M	S	S	M	M
CO6	S	M	M	M	M	L	L	S	S	L
CO7	S	S	S	S	L	M	L	L	L	S

S- Strong; M-Medium; L-Low

Course code	20CS2E2	IMAGE PROCESSING	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	4	0	4
Pre-requisite		To provide strong foundation to student bring Image processing procedures and practices	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To learn the fundamentals of image processing and its relationship between pixels.						
2. To understand focuses on different logical operators which help students to enhance images.						
3. To understand the key concepts of image compression this estimates the degradation function.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand about the fundamentals of digital image processing,Sampling and quantization.				K1/ K2	
2	Understand about image enhancement, histogram processing and Filtering techniques				K2 / K3	
3	Explain about image restoration and transformations.				K2 / K4	
4	Understand the concepts of color fundamentals and models.				K2 / K4	
5	Understand the importance of image compression				K1 / K3	
6	Understand about morphological issues in image processing				K2/ K3	
7	Exploring the concepts of Image segmentation				K2/ K3 / K4	
8	Examine the use of classifiers and neural networks				K2/ K3 / K4	

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		
Unit:1	Introduction	10 hours
Digital image processing - Fundamental steps in digital image processing - components of image processing system. Digital Image Fundamentals: A simple image formation model -image sampling and quantization - basic relationships between pixels.		
Unit:2	Image Enhancement in the Spatial Domain	12 hours
Basic gray-level transformation – histogram processing, enhancement using arithmetic and logic operators - basic spatial filtering – smoothing and sharpening spatial filters - combining the spatial enhancement.		
Unit:3	Image Restoration	15 hours
A model of the image degradation/restoration process – noise models - restoration in the presence of noise–only spatial filtering - Wiener filtering – constrained least squares filtering - geometric transforms; Introduction to the Fourier transform and the frequency domain - estimating the degradation function.		
Unit:4	Color Image Processing	10 hours
Color fundamentals - color models - pseudo color image processing - basics of full– color image processing - color transforms - smoothing and sharpening - color segmentation. Image Compression: Fundamentals - image compression models - error-free compression –lossy predictive coding - image compression standards.		
Unit:5	Morphological Image Processing	11 hours
Preliminaries - dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms. Image Segmentation: Detection of discontinuous - edge linking and boundary detection – thresholding - region–based segmentation. Object Recognition: Patterns and patterns classes - recognition based on decision– theoretic methods – matching - optimum statistical classifiers - neural networks - structural methods – matching shape numbers - string matching.		
Unit:6	Case Study	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Books		
1	RafealC.Gonzalez, Richard E.Woods, Digital Image Processing, Fourth Edition, Pearson Education/PHI,2018	
2	S. Sridhar,Digital Image Processing,Oxford University Press,2016	
Reference Books		
1	Jain, Fundamentals of Digital Images Processing,Pearson Education India; First edition 2015	
2	Jayaraman , Digital Image Processing, McGraw Hill,2009	
3	Alasdair McAndrew, Introduction to Digital Image Processing with Matlab, Thomson Course Technology,2004	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc19_ee55/preview	
2	https://nptel.ac.in/courses/117/105/117105079/	
3	https://www.coursera.org/learn/digital	

4	https://www.tutorialspoint.com/dip/index.htm
5	https://www.electronicsforu.com/videos-slideshows/digital-image-processing
Course Designed By: Dr. D.NAPOLEON	

Mapping with programme outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	M	M	M	S
CO2	S	M	M	M	L	M	S	M	M	M
CO3	M	S	L	M	S	S	S	S	M	S
CO4	S	S	M	S	S	M	S	S	S	S
CO5	S	S	L	L	L	S	L	M	L	M
CO6	S	M	L	S	M	M	S	M	L	M
CO7	M	L	L	S	S	L	M	M	M	L
CO8	S	M	M	L	S	M	M	L	M	L

S- Strong; M-Medium; L-Low

Course code	20CS2E3	MOBILE COMMUNICATIONS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	4	0	4
Pre-requisite		Fundamentals of Mobile Communications and Telecommunication Architecture	Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
1. To provide the strong foundation to students on Mobile Communications and its generations, basic architecture of cellular devices, digital cellular infrastructure, GSM, principles of synchronous digital hierarchy, Pleisiosynchronous digital hierarchy and fiber optics communications						
2. To focus on Mobile switching systems, Base station sub systems and Network management systems.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Remember the basic principles of mobile communications and its generations along with basic cellular architecture.				K1/K2	
2	Understand the concept of GSM and its architecture.				K1/K2	
3	Analyze about the principles of synchronous digital hierarchy, Pleisiosynchronous digital hierarchy and fiber optics communications.				K2/K4	
4	Understand about Mobile service switching centre and inter working functions (IWF) and Gateway MSC.				K1/K2	
5	Evaluate the concepts of home location register (HLR) and Visitor Location register (VLR), Signaling Transfer Point (STP)				K3/K5	
6	Analyze the use Base station controller, base transceiver station and transcoder rate adaptation unit and promote the use of open system interconnection and frequency management.				K2/K4	

7	Evaluate the Network Management systems operations, maintenance and administration, subscription management, charging and mobile equipment management.	K4/K5
8	Create new theories and formulation of hypothesis	K3/ K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Unit:1	Introduction	12hours
Introduction: Introduction to mobile communications – generation of mobile communication FM, TDMA, CDMA – basic cellular architecture.		
Unit:2	Digital Cellular System Infrastructure	12hours
Digital cellular system infrastructure: Global system for mobile communication (GSM) – GSM architecture – principles of synchronous digital hierarchy – principles of Pleiosynchronous digital hierarchy – principles of fiber optics communications.		
Unit:3	Mobile Switching Systems	12hours
Mobile switching systems: Mobile service switching centre (MSC) – inter working functions (IWF) – home location register (HLR) and Visitor Location register (VLR) – Gateway MSC – Signaling transfer point (STP)		
Unit:4	Base Station Sub Systems	12 hours
Base station sub systems: Base station controller (BSC) – base transceiver station (BTS) – transcoder rate adaptation unit (TRAU) – open system interconnection – frequency management.		
Unit:5	Network Management Systems	10 hours
Network management systems: Operating sub systems – network operation, maintenance and administration – subscription management and charging – mobile equipment management.		
Unit:6	Application & Case Studies	02hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60hours
Text Books		
1	Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education, 2011.	
2	William Stallings, “Wireless Communications and Networks”, Pearson Education, 2014.	
Reference Books		
1	Gordon, L. Principles of mobile communication. Springer International Publishing AG,2018	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Systems & Network - https://www.snt.co.uk/training_courses/Telecommunications/Mobile_communications_overview_course.htm	
2	https://www.coursera.org/learn/wireless-communication-technologies	
3	http://logic-instrument.com/ressources/Forestry-EN.php	
4	http://www.mobileinfo.com/Case_Study/index.htm	
Course Designed By: Dr. P.B.Pankajavalli		

Mapping with programme outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	L	M	L	L	L	M
CO2	S	M	L	L	M	L	M	L	M	L
CO3	M	M	L	M	L	L	L	M	L	M
CO4	S	S	L	M	L	L	L	M	L	M
CO5	M	S	L	M	L	M	L	L	L	M
CO6	S	S	M	M	L	M	L	L	M	L
CO7	S	S	M	M	L	L	L	L	L	L
CO8	L	L	S	L	M	L	L	L	L	M

S- Strong; M-Medium; L-Low

Course code	20CS3E1	MACHINE LEARNING TECHNIQUES	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	4	0	4
Pre-requisite		Degree level knowledge in the field of computer and programming skills	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. Present the foundations of Artificial Intelligence and machine learning techniques and make the students to understand Machine Learning Models						
2. Enrich the student skill in suggesting machine learning strategy applicable to the given problem						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand objectives of artificial Intelligence and machine learning, Types of Learning Understand training and testing					K2
2	Understand Linear Classification, Concept of univariate and multivariate linear regression Understand Multilayer neural Networks Understand and analyse SVM and Soft SVM					K2/K3/ K4
3	Understand models - Nearest neighbour models, K means clustering, Hierarchical clustering, K- D trees, Ensemble learning methods Analysing Bagging, random forest and Meta learning					K2/K4
4	Understand Decision tree, , analysing estimation trees and Regression trees,					K2/K3/

	Learning ordered rule list and Applying Association rule mining to the given problem	K4
5	Understand reinforcement learning, its application in game playing and applications in robot control.	K2/K3/ K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		
Unit:1	Foundations of Learning	12 hours
Introduction Artificial Intelligence -Characteristics of AI – AI problems and Problem solving methods- Components of learning – learning models – geometric models – probabilistic models – logic models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound –bias and variance – learning curve.		
Unit:2	Linear Models	12 hours
Linear classification – univariate linear regression – multivariate linear regression – regularized regression – Logistic regression – perceptrons – multilayer neural networks – learning neural networks structures – support vector machines – soft margin SVM – generalization and over fitting – regularization – validation		
Unit:3	Distance-Based Models	12 hours
Nearest neighbor models – K-means – clustering around medoids – silhouettes – hierarchical clustering – k- d trees – locality sensitive hashing – non - parametric regression – ensemble learning – bagging and random forests – boosting – meta learning.		
Unit:4	Tree And Rule Models	11 hours
Decision trees – learning decision trees – ranking and probability estimation trees – Regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining – first -order rule learning		
Unit:5	Reinforcement Learning	11 hours
Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal - difference learning – active reinforcement learning – exploration – learning an action utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control		
Unit:6	Contemporary Issues	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours
Text Books		
1	Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill Publication, 2 nd Edition, 2001	
2	Y. S. Abu - Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.	

3	P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012
Reference Books	
1	K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.
2	C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
3	D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, 2012.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.geeksforgeeks.org/machine-learning/
2	https://www.tutorialspoint.com/machine_learning_with_python/
Course Designed By: Dr. K. Geetha	

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

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

Course code	20CS3E2	E-COMMERCE	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	4	0	4
Pre-requisite		Basic knowledge in World Wide Web and Internet	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. Inculcate the knowledge on the fundamentals of E-Commerce						
2. Present the network infrastructure and information distribution and managing.						
3. Examine the ideas and techniques underlying the design of information publishing and description of the electronic payment systems, search engines and agents.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Remember and Understand the introduction of E-Commerce				K1/K2	
2	Remember and Understand LAN, WAN, FTP and WWW				K1/K2	
3	Rememberand Understand Web Browsers, Multimedia Contents, and Security				K1/K2	
4	Understand and Apply Electronic Payment Systems to various domains				K2/K3	

5	Analyze and Evaluate Search Engines and Directory Services	K4/K5
6	Create different e- commerce web sites based on the requirements	K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Unit:1	INTRODUCTION	10hours
Introduction to E-Commerce: Benefits-Impacts-Classification and Application of E-Commerce-Business Model-Architectural Frame Work		
Unit:2	NETWORK CONCEPTS	12hours
Network Infrastructure: Local Area Network-Ethernet-Wide Area Network-Internet-TCP/IP Reference Model-Domain Name System-Internet Industry structure - Information Distribution and Messaging: FTP Application-Electronic Mail-World Wide Web Server-HTTP-Web Server Implementations		
Unit:3	INFORMATION PUBLISHING TECHNOLOGY	12hours
Information Publishing Technology: Information Publishing - Web Browsers – HTML - CGI Multimedia Content - Other Multimedia Objects -VRML- Securing the Business on Internet - Why Information on Internet is vulnerable? - Security Policy - Procedures and Practices - Site Security Protecting the Network - Firewalls - Securing the Web Service		
Unit:4	ELECTRONIC PAYMENT SYSTEMS	12hours
Securing Network Transaction-Electronic Payment Systems: Introduction –Online Payment Systems-Pre-paid Electronic Payment System- Post-paid Electronic Payment System-Requirement Metrics of a Payment System		
Unit:5	SEARCH ENGINES AND AGENTS	12hours
Search Engines and Directory Services: Information Directories –Search Engines –Internet Adverting- Agents in Electronic Commerce: Needs and Types of Agents-Agent Technologies Agents Standards and Protocols-Agents Applications-Case Study		
Unit:6	AUGMENTED REALITY E-COMMERCE	02hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60hours
Text Book(s)		
1	Bharat Bhasker, “Electronic Commerce Framework, Technologies and Applications”, Tata McGraw Hill Publication, 2003.	
Reference Book(s)		

1	Henry Chan, Raymond Lee, Tharam Dillon, Elizabeth Chang, E-Commerce: Fundamentals and Applications, The Wiley Foundation, July 2003
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd2_cec19_cm01/preview
2	https://thinkmobiles.com/blog/augmented-reality-ecommerce/
3	https://www.avexdesigns.com/blog/augmented-reality-e-commerce
4	https://www.w3schools.com/
Course Designed By: Dr. D.Ramyachitra	

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	L	M	M	L	L	M
CO2	M	S	M	M	M	L	M	M	L	M
CO3	M	L	L	M	L	L	L	L	L	M
CO4	M	L	M	S	M	L	L	M	L	L
CO5	S	M	L	M	L	L	M	L	S	M
CO6	S	L	L	M	L	M	M	L	M	M

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

Course code	20CS3E3	OPEN SOURCE TECHNOLOGIES	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	4	0	4
Pre-requisite		To know the fundamentals of Open Source and Its Techniques	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To understand excellent web development solutions that brings your ideas to life on the web.						
2. To be a global, customer-centric company enabling business to craft their unique & successful identities on the web and mobile.						
3. To encourage a shared community approach to the development, extension, and patching of open source software.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the Open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, History : BSD, The Free Software Foundation and the GNU Project, Philosophy				K3	
2	Understand the Philosophy: Software Freedom, Open Source Development Model, Licenses and Patents, Economics of FOSS - Zero Marginal Cost, Income-generation opportunities, Problems with traditional commercial software, Internationalization				K3	

3	Understand the Open Source Platform and Technologies: The Open Source Platform–Operating Systems, Windowing Systems and Desktops, GIMP, Technologies Underlying Open source Development.	K2 / K4
4	Understand the Linux Application: Accessing and Running Applications-Multimedia in Linux : Listening to Audio, Playing video, Using Digital Camera, Recording music / video CDs. Publishing: Open office, Working with Graphics, Printing Documents, Displaying documents with Ghost script and Acrobat, Using Scanners driven by SANE	K2 / K3/ K4
5	Understand the PHP: Installing and Configuring PHP, Building Blocks of PHP, Flow control functions in PHP, Working with functions, arrays, objects and forms. Understand the PHP and MySQL Integration: Database Design Process, Learning Basic SQL commands, Using Transactions and Stored Procedures in MySQL, Interacting with MySQL using PHP.	K2 / K3/ K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		
Unit:1	Introduction	12 hours
Free Software - Free Software vs. Open Source software - Public Domain Software - History : BSD - The Free Software Foundation and the GNU Project - Philosophy: Software Freedom - Open Source Development Model - Licenses and Patents - Economics of FOSS - Zero Marginal Cost - Income-generation opportunities - Problems with traditional commercial software - Internationalization.		
Unit:2	Open Source Platform and Technologies	12 hours
The Open Source Platform–Operating Systems - Windowing Systems and Desktops - GIMP - Technologies Underlying Open source Development.		
Unit:3	Linux Application	12 hours
Accessing and Running Applications-Multimedia in Linux : Listening to Audio, Playing video - Using Digital Camera, Recording music / video CDs. Publishing: Open office - Working with Graphics - Printing Documents - Displaying documents with Ghost script and Acrobat - Using Scanners driven by SANE		
Unit:4	PHP	10 hours
Installing and Configuring PHP - Building Blocks of PHP - Flow control functions in PHP - Working with functions – arrays - objects and forms.		
Unit:5	PHP and MySQL Integration	12 hours
Understanding the Database Design Process - Learning Basic SQL commands - Using Transactions and Stored Procedures in MySQL, Interacting with MySQL using PHP		
Unit:6	Industry 4.0	2 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	60 hours

Text Book(s)	
1	Open Source Technology: Concepts, Methodologies, Tools, and Applications 1st Edition, IGI Global, Information Resources Management Association, 1 st Edition, 2014
2	Open Source Technology: Concepts, Methodologies, Tools, and Applications, November, 2014
3	Kailash Vadera, Bhavyesh Gandhi, Open Source Technology, Laxmi Publications, 2009
Reference Book(s)	
1	Fadi P. Deek, James A. M. McHugh Open Source: Technology and Policy, Cambridge University Press, 2008
2	Understanding Open Source and Free Software Licensing -By Andrew M. St. Laurent, Oreilly Media
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.mooc-list.com/tags/open-source
2	https://www.coursera.org/specializations/oss-development-linux-git
3	https://tavaana.org/sites/default/files/introduction_to_opensource.pdf
4	http://www.dreamtechpress.com/product/linux-labs-and-open-source-technologies-2/
5	https://echopx.com/opensource-technology/
Course Designed By: Dr. D. Napoleon	

Mapping with programme outcomes:

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

S- Strong; M-Medium; L-Low

SUPPORTIVE PAPERS

Course code	20CSS01	WINDOWS AND MS WORD	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	2	0	0	2
Pre-requisite		Knowledge in Basics of Computer	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide in depth knowledge about the basic concepts of operating system						
2. To discuss the file operations and document creation						
3. To inculcate knowledge on office tools and techniques, graphics and toolbars						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basics of operating system and various menus				K2/K3	
2	Learn the windows operation and file management				K2/K3/K4	
3	Understand and learn the document creation				K2/K3	
4	Analyze the usage various tools and macros				K3/K4	
5	Create and evaluate the reports generated				K5/K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1		Introduction			5 hours	
Getting started –about OS – types of OS – mouse handling – Windows						
Unit:2		File operations			6 hours	
Office User Interface – Creating, Saving, Closing and Opening Office files, Working with files						
Unit:3		Document creation and Customization			6 hours	
Creating and Editing Documents – Formatting and Customizing Documents.						
Unit:4		Graphics and toolbars			8 hours	
Tabs – tables and sorting – graphics – templates writer tools – macros – keyboard shortcuts – means – custom toolbars.						
Unit:5		Report Writing			5 hours	
Collaborating with others and Working with reports						
	Total Lecture hours			30 hours		
Text Book(s)						
1	Randy Nordell, Microsoft Office 365: In Practice, 2019 Edition					
2	Joan Lambert and Curtis Frye, Microsoft Office 2016 Step By Step, Microsoft Press, 2015.					
Reference Book(s)						
1	Woody Leonhard, Microsoft office 2000, Que 1999.					
Course Designed By: Dr. D.Ramyachitra						

Course Code	20CSS02	INTERNET AND HTML PROGRAMMING	L	T	P	C
Core/Elective/Supportive	SUPPORTIVE		2	0	0	2
Pre-requisite	Basic knowledge in Computer Science		Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To understand the fundamentals of Internet and WWW						
2. To learn about the basics of internet services						
3. To develop basic web pages using HTML						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Remember the basic concepts of Internet and its connectivity.				K1/K2	
2	Understand the concepts of World wide web				K1/K2	
3	Gain knowledge on internet services, its address and basic understanding on HTML				K2/K3	
4	Understand and apply html tag for web page creation.				K1/K3	
5	Create tables, forms and frames in HTML.				K3 /K4 /K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;						
Unit:1	Introduction to Internet				5hours	
Internet Basics –Origin Of Internet – Arpanet - Gateway- Internet Service Providers- Servers- Modems - Dialup Networking - Web Browsers- Routers .						
Unit:2	The World Wide Web				5hours	
Introduction to World Wide Web, Web Pages and Contents, Web Clients, Web Servers, Web Applications, Websites – Home Pages –URL - Search Engines.						
Unit:3	Internet Services & HTML				10 hours	
Electronic Mail- FTP- Newsgroups- TCP/IP- DNS- IP addressing- Classification of IP address- History of HTML - Structure of HTML document - Switching between Editor and Browser- Paragraph and Line Break Tags - Adding Comments.						
Unit:4	HTML Tags :				10hours	
Formatting Text - Ordered List - Unordered List Tag - Creating Links using text and images. Tables: Tables: Creating Columns and Rows- Adding a Border- Adding Column Headings - Adding Spacing and Padding - Adding a Caption - Setting the Table Width and Height.						
Unit:5	HTML Frames & Forms				10 hours	
Frames : Percentage dimensions - Relative dimensions - Creating two rows Frames - Creating two columns frames - Creating two rows and the second row containing two columns. Forms: Form Tag- Method – Action - Input Tag - Type Attribute: Check box, Hidden, Image, Radio, Reset, Submit, Text.						
				Total Lecture hours		30 hours

Text Book(s)	
1	Hohn Levine and Margaret Levine , “Internet for Dummies “, Wiley, 14 th Edition.
Reference Book(s)	
2	John Duckett, “Beginning Web Programming with HTML, XHTML, CSS & JavaScript”, Wiley DreamTech Second Edition.
Related Online Contents	
1.	https://ncert.nic.in/textbook/pdf/kect107.pdf
2.	https://ftms.edu.my/v2/wp-content/uploads/2019/02/csca0101_ch09.pdf
Course Designed By: Dr.P.B.Pankajavalli	

Course code	20CSS03	RELATIONAL DATABASE MANAGEMENT SYSTEMS	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	2	0	0	2
Pre-requisite		Knowledge in Basics of Computer	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide in depth knowledge about the basic concepts database systems						
2. To discuss the database models and relational database						
3. To inculcate knowledge on normalization and query processing						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basics of database systems and transaction management				K2/K3	
2	Learn different database models				K2/K3/K4	
3	Understand and learn the structure of relational databases				K2/K3	
4	Analyze the application of normalization to tables				K3/K4	
5	Create and evaluate the queries for the applications				K5/K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1		Introduction to Database Systems			5 hours	
Introduction – purpose of database system data models – database languages – Transaction management – Storage management – DBA – database users – system structure						
Unit:2		Database Models			6 hours	
E-R model – Hierarchical model – Network Model.						
Unit:3		Relational Database			6 hours	
Structure of Relational databases – Relational Commercial Languages SQL – Integrity Constraints.						

Unit:4	Normalization	8 hours
Normalization – Indexing and Hashing		
Unit:5	Query Processing	5 hours
Query Processing – Concurrency Control – Security		
	Total Lecture hours	30 hours
Text Book(s)		
1	Abraham Silberchatz, Henry K.Forth, Sudharshan, Database system Concepts, McGraw Hill, 7 th Edition, 2020.	
Reference Book(s)		
1	Navethe/Elmasri,” Fundamentals of Database Systems”, Addition Wesley, Sixth Edition, 2010.	
Course Designed By: Dr. D.Ramyachitra		

Course code	20CSS04	OBJECT ORIENTED PROGRAMMING	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	2	0	0	2
Pre-requisite		Knowledge in Basics of Computer	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide knowledge on introductory concepts on object oriented programming						
2. To discuss the control statements, classes and the characteristics of object oriented programming						
3. To inculcate knowledge on files and exception handling						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basics of object oriented programming				K2/K3	
2	Learn different control statements and objects and classes				K2/K3/K4	
3	Understand and learn the characteristics of object oriented programming				K2/K3	
4	Understand the application of files and templates				K2/K3	
5	Analyze the concepts, evaluate and create object oriented programs				K4/K5/K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Introduction to Object Oriented Programming				5 hours	
Drawback of structured programming – object oriented language characteristics and fundamentals – programming basics						

Unit:2	Control Statements and Classes	6 hours
Loops, decisions – structures and functions – object and classes.		
Unit:3	OOPs Characteristics	6 hours
Overloading – Inheritance – Polymorphism		
Unit:4	Files and Templates	8 hours
Files – Streams – Templates		
Unit:5	Exception and String Handling	5 hours
Exception handling – String handling		
	Total Lecture hours	30 hours
Text Book(s)		
1	Strongstrup, “The C++ Programming Languages”, Addison Wesley, 4 th Edition, 2013	
Reference Book(s)		
1	Robert Lafore, “Object Oriented Programming in Turbo C++,” Galgotha publications Ltd , 2001.	
Course Designed By: Dr. D.Ramyachitra		

Course code	20CSS05	SOFTWARE ENGINEERING	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	2	0	0	2
Pre-requisite		Knowledge in Basics of Computer	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide knowledge on introductory concepts on Software Engineering						
2. To discuss system analysis and design methods						
3. To inculcate knowledge on software testing						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basics of software engineering				K2/K3	
2	Learn requirement analysis and data modeling				K2/K3/K4	
3	Understand the design concepts and modular design				K2/K3	
4	Understand the application of design methods for real time systems				K2/K3	
5	Analyze the analysis, design and testing concepts, evaluate and create software products				K4/K5/K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1		Introduction to Software Engineering			5 hours	
Introductions: Evolving role of software – Software characteristics, components and its applications – Generic view of software engineering – Software process models.						
Unit:2		System Analysis			6 hours	
Systems Analysis: Requirements analysis – Analysis principles – Prototyping Software requirement specification – Data modeling, functional modeling and behavioral modeling						
Unit:3		System Design			6 hours	
Design concepts: Design and software quality, Design concepts: Abstraction, refinement, modularity, and software architecture control hierarchy structural partitioning and information hiding, Effective modular design: functional independence, cohesion and coupling – design documentation.						
Unit:4		Design Methods			8 hours	
Design Methods: Data design – Architectural design process: transform mapping and transaction mapping – interface design – procedural design. Design for Real – Time Systems: System considerations – Real time systems – analysis and simulation of real time systems.						
Unit:5		Software Testing			5 hours	

Software Testing Methods: Software testing fundamentals. White box testing: basis path testing and control structure testing – black box testing – testing for specialized environments. Software Testing Strategies: A strategic approach to software testing – unit testing – Integration testing – Validation testing— System Testing.		
	Total Lecture hours	30 hours
Text Book(s)		
1	Roger.S.Pressman, Software Engineering: A Practitioners Approach, Tata McGraw Hill, 2014.	
Course Designed By: Dr. D.Ramyachitra		

Course code	20CSS06	MULTIMEDIA SYSTEMS	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	2	0	0	2
Pre-requisite		Knowledge in Basics of Computer	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide knowledge on introductory concepts on multimedia						
2. To discuss about sound and graphics in multimedia systems.						
3. To inculcate knowledge on operations on video, animation and special visual effects.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basics of Multimedia systems				K2/K3	
2	Learn sound, editing sound files and graphics				K2/K3/K4	
3	Understand and learn the video concepts and digital filters				K2/K3	
4	Understand the application of animation tools				K2/K3	
5	Analyze, evaluate and create systems using special visual effects				K4/K5/K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1		Introduction to Multimedia			5 hours	
Introduction to Multimedia PCs – Components of Multimedia – Multimedia Tools						
Unit:2		Sound and Graphics			6 hours	
Digital Sound - Editing and Mixing Sound Files – MIDI Creation – Tracking Procedure – Interactive and Non-Interactive Graphics						
Unit:3		Video Concepts			6 hours	
Digital Image Concepts - Video Capturing – Scanning Images – Digital Filters – Morphing and						

Warping		
Unit:4	Animation	8 hours
Two dimensional and Three-dimensional animation – Animation tools		
Unit:5	Imaging Special Visual Effects	5 hours
Bitmap – Brushes – Dissolve – Hotspot Editor - Scrolling		
	Total Lecture hours	30 hours
Text Book(s)		
1	TayVaughan, Multimedia Making it Work, Tata McGrawHill Publishing Company, Eighth Edition, 2011.	
2.	KaliyaperumalKarthikeyan, Introduction to Multimedia System, Lambert Academic Publishing, 2011.	
Reference Book(s)		
1	ParagHavaldar, Gerald Medioni, Multimedia Systems, Cengage Learning, 2011	
2	S.K.Bansal , Multimedia Systems, Aph Publishing Corporation, 2011.	
Course Designed By: Dr. D.Ramyachitra		

Job Oriented Course

MOBILE APPLICATION DEVELOPMENT	
Name of the Department	Computer Science
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	Dr. R. Porkodi Associate Professor Department of Computer Science Bharathiar University Coimbatore – 46 0422-2428349 porkodi_r76@buc.edu.in
Inter / Intra Department Course	Intra Department Course
Duration of the Course	30Hours
Eligibility	U.G. in Computer Science/Computer Applications/Information Technology or its equivalent
Number of Candidates to be Admitted	40
Mode of the Course	Both Regular and Online
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.)	---
Registration Procedure	
Job Opportunities:	
<ul style="list-style-type: none"> To become mobile app developer in Retail, healthcare sector, Travel and tourism industry, Entertainment industry, Financial services and Media organizations. 	
The objectives of the Course are:	
1	Provides a comprehensive overview and focuses on developing multiplatform mobile applications using the Web skills.
2	Strengthen the skills of students in learning hybrid application framework to develop and target multiple mobile platforms with a single codebase.
3	Enrich the knowledge of students in Ionic one of fastest growing mobile application framework.
4	
Course Outcomes:	
On the successful completion of the course, student will be able to:	
1	Understand the basics of mobile devices, app store, development environments, characteristics, history of mobile application frameworks.

2	Understand the mobile application frameworks and setting up java, eclipse, android development components. Creating user interface design for mobile applications and managing application data.	
3	Understanding the enterprise requirements and testing methodologies for mobile applications.	
4	Understanding the hybrid mobile app development frameworks: CSS3, HTML 5, Ionic, Angular JS, Node.JS and developing the hybrid mobile applications	
5	Understanding the mobile app deployment process, Usage of Sqlite, mongo DB and Mysql and IBM BlueMix.	
Course Content		Lecture / Practical / Project / Internship
Module 1	Introduction to Mobile Devices: Introduction - Mobile vs. Desktop devices - App Store, Google Play, Windows Store - Development environments – Phone GAP	5 hours
Module 2	Native vs. web applications - Mobile Connectivity Evolution - Characteristics of mobile applications - History of mobile application frameworks	5 hours
Module 3	Application models of mobile application frameworks - Setting up an android development environment: setting up java, eclipse, android development components, verify the development environment	4 hours
Module 4	User interface design for mobile applications - Managing application data	6 hours
Module 5	Addressing enterprise requirements in mobile applications: performance, scalability, modifiability, availability, and security	4 hours
Module 6	Testing methodologies for mobile applications - Publishing, deployment, maintenance and management	6 hours
Module 7	Hybrid Mobile App Development Frameworks: Introduction to CSS3.HTML5 - Full-Stack Web Development	7 hours
Module 8	Hybrid Mobile App Development: Ionic and AngularJS - node.JS	8 hours
Module 9	APP deployment: Angular ui-router and Resolve - Using Local Storage(Sqlite) -Databases - mongoDB, MySQL	7 hours
Module 10	Ionic Adding Platforms - Building and Deploying the App - Hybrid Mobile Development and IBM BlueMix	8 hours
Text Book(s)		
1	Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano, Android Programming: The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 3rd edition, 2017.	

2	Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK 3 for Dummies, Wiley.
3	Brian Fling, Mobile Design and Development, O'Reilly Media, Inc., 2009.
Reference Book(s)	
1	MaximilianoFirtman, Programming the Mobile Web, O'Reilly Media, Inc., 2nd ed., 2013.
Related Online Contents	
1	https://developer.android.com/
2	https://www.w3schools.in/category/android-tutorial/
3	https://www.tutorialspoint.com/android/index.htm

SMART APPLICATIONS WITH INTERNET OF THINGS	
Name of the Department	Computer Science
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	Dr.P.B.Pankajavalli Assistant Professor Dept. of Computer Science Bharathiar University, Coimbatore Phone : 2428603, pankajavalli@buc.edu.in
Inter / Intra Department Course	Intra Department Course
Duration of the Course	30 Hours
Eligibility	U.G. in Computer Science/Computer Applications/Information Technology or its equivalent
Number of Candidates to be Admitted	40
Mode of the Course	Both Regular and Online
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.)	No
Registration Procedure	
Job Opportunities:	
Hardware and device development, Sensor networking professionals	
IoT cloud engineer, Product Manager	
The objectives of the Course are:	
The main objectives of this course are to:	
1	To understand the concept of sensors and microcontrollers
2	To remember basic syntax in C programming
3	To apply sensor on microcontrollers
4	To understand the interfacing of cloud with sensors
5	To evaluate and visualize the data in the cloud
Expected Course Outcomes:	

1	Understand the basics of sensors and sensor networks	K2/K3
2	Create basic arduino code and to gain knowledge on built in code	K1/K2/K4
3	Develop small IoT prototype using different sensors.	K3/K4
4	Explore the usage of buzzers, motors, relays and LED lights	K3/K4
5	Deploy interface with cloud and to visualize data	K2/K3/K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5- Create		
Course Content		Lecture / Practical / Project / Internship
Smart Applications with Internet of Things (30 Hours, 2 credits)		
Module 1	Anatomy of Sensors Networks – Topology of Sensor Network – Type of Sensor Nodes – Sensors- Sensors measures	2 hours
Module 2	Analog Sensors- Digital Sensors – Storing sensor data – Examples	2 hours
Module 3	Understanding the Arduino board – Arduino Board types- Virtronics Simulator for Arduino- Tinkercad -Arduino IDE - Installing and Setting up the Arduino IDE - Connecting the Arduino IDE with devices	3 hours
Module 4	Program Structure in C - Basic Syntax - Data Types / Variables / Constants - Operators, Conditional Statements and Loops - Functions, Array and Pointers - Strings and I/O - Arduino C Library functions - Working with Arduino inbuilt examples.	4 hours
Module 5	Understanding Sensors and Devices - Understanding basic electronic components and power elements - Understanding the Inputs from Sensors - Working with Temperature Sensors, Ultrasound Sensor, Humidity sensor, Motion Sensor	3 hours
Module 6	Working with IR Sensor - Working with Proximity Sensor - Working with Photo Diode - Working with Accelerometer and vibration sensor - Introduction to Raspberry Pi.	3 hours
Module 7	Understanding the Outputs - Activating LED Lights - Activating Relays - Activating Buzzer	3 hours
Module 8	Running DC Motors - Running - Stepper Motors and Servo Motors	3 hours
Module 9	Introduction to cloud – ThingspeakIoT Analytics Platform – API key – Thingspeak login – API Key Process	3 hours
Module 10	ESP8266 WI-FI Module – Installation of ESP8266 board package to Arduino IDE – Circuit Diagram – Graph visualization – Introduction to Adafruit, Bolt, Blynk, and IFTTT	4 hours
Text Book(s)		
1	Michael Margolis, “Arduino Cookbook” 2nd Edition, O'Reilly Media, 2011.	
2	Charles Bell, “Beginning Sensor Networks with Arduino and Raspberry Pi”, 1 st Edition, Technology in Action, 2013.	

Reference Book(s)	
1	ArvindRavulavaru, Enterprise Internet of Things Handbook: Build end-to-end IoT solutions using popular IoT platforms, Packt Publishing Limited, 2018.
Related Online Contents	
1	https://electronics-project-hub.com/send-data-to-thingspeak-using-esp8266/
2	https://virtronics.com.au/Simulator-for-Arduino.html
3	https://www.instructables.com/id/ESP8266-to-IFTTT-Using-Arduino-IDE/
Course Designed by: Dr.P.B.Pankajavalli	

Value Added Course

AUGMENTED REALITY	
Name of the Department	Computer Science
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	Dr.D.Ramyachitra Assistant Professor Department of Computer Science Bharathiar University Coimbatore – 641 046. Phone : 9994374370 E mail : ramyachitra@buc.edu.in
Inter / Intra Department Course	Intra Department Course
Duration of the Course	30 Hours
Eligibility	U.G. in Computer Science/Computer Applications/Information Technology or its equivalent
Number of Candidates to be Admitted	40
Registration Procedure	
Job Opportunities: AR Content Developer, AR User Experience Designer, AR Community Manager, AR Project Manager	
The objectives of the Course are:	
The main objectives of this course are to:	
1	Inculcate the knowledge on the fundamentals of Augmented Reality
2	Present the different types of AR
3	Learn the different techniques of AR
4	Examine the tools of AR
5	Solve real time problems using AR

Course Content		Lecture / Practical / Project / Internship
Expected Course Outcomes		
On the successful completion of the course, student will be able to:		
1	Understand and Remember the basic concepts of Augmented Reality	K1/K2
2	Understand and Remember the functionalities of AR Systems	K1/K2
3	Analyze the types of AR based on the requirements	K2/K4
4	Analyze and Evaluate the tools for implementing AR Systems	K4/K5
5	Create AR Systems for specific problems	K2/K3/K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		
Module 1	Augmented Reality – Taxonomy, technology and features of Augmented Reality -Difference between Augmented Reality and Virtual Reality – Challenges with AR	2 hours
Module 2	AR Systems and functionality – Displays – head mounted – handheld – projective – auditory – haptic	2 hours
Module 3	Types of AR – Marker Based – Markerless	2 hours
Module 4	Types of AR - Projection Based – Superimposition	2 hours
Module 5	Techniques – Visualization – Interaction - Registration	8 hours
Module 6	Tools – Vuforia – Wikitude	6 hours
Module 7	ARToolKitX – ARCore – ARMedia	9 hours
Module 8	Applications and Case studies – Education – Tourism	3 hours
Module 9	Manufacturing – Retail industries	3 hours
Module 10	Repair and Maintenance – Health Care	3 hours
Text Book(s)		
1	Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013	
2	Dieter Schmalstieg, Tobias Hollerer, Augmented Reality: Principles and Practice, Pearson Education, 1 st Edition, 2016	
Related Online Contents		
1	https://pubmed.ncbi.nlm.nih.gov/32275601/	
2	https://www.digit.in/technology-guides/fasttrack-to-augmented-reality/welcome-to-augmented-reality.html	
3	https://www.coursera.org/learn/ar	

REMOTE SENSING AND GIS		
Name of the Department		Computer Science
Name of the Faculty Member i/c With Complete Address with Phone and e-mail		Dr.D.Napoleon Assistant Professor Department of Computer Science Bharathiar University Coimbatore – 641 046. Phone : 9655162717 E mail : mekaranapoleon@yahoo.co.in
Inter / Intra Department Course		Intra Department Course
Duration of the Course		30 Hours
Eligibility		U.G. in Computer Science/Computer Applications/Information Technology or its equivalent
Number of Candidates to be Admitted		40
Registration Procedure		
Job Opportunities: GIS Analysts/Sr. GIS Analyst,GIS Engineer, Senior GIS Executive,Sr. Modeling Analyst		
The objectives of the Course are:		
The main objectives of this course are to:		
1	Explain the basics of geographic information systems (GIS) and related areas such as geodesy and remote sensing	
2	Select and acquire both primary and secondary spatial data for use in GIS	
3	Manage, and analyze digital data in raster and vector formats	
4	Describe how common analytical methods and techniques work	
5	Create and present a GIS project.	
Course Content		Lecture / Practical / Project / Internship
Expected Course Outcomes		
On the successful completion of the course, student will be able to:		
1.	Understand and Remember the basic concepts of remote sensing	K1/K2
2.	Understand and Remember the functionalities of GIS-Photogrammetry	K1/K2
3.	Analyze the Statistical Concepts based on the Images	K2/K4
4.	Analyze and Evaluate the case studies	K3/K4/k5
5.	Create and analyze environmental Monitoring and Assessment	K2/K4/K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		
Module 1	Fundamentals & Physics of Remote Sensing- Platforms and Sensors- Fundamentals of Geographic Information System-Digital Cartography- Photogrammetry-Surveying and Global Positioning System	2 hours

Module 2	Fundamentals of GIS-Photogrammetry, Surveying& GPS-Information Extraction from Satellite Images-Thermal and Microwave Remote Sensing-Hyper spectral Remote Sensing	2 hours
Module 3	GIS Data Analysis-Geodesy-Fundamental Statistical Concepts-Geo-statistics & Statistical applications in GIS	4 hours
Module 4	Advance Remote Sensing: Data Processing & Applications-Fundamental Statistical Concepts & Geo-Statistics	4 hours
Module 5	Application of Geo-informatics-Spatial decision support system	6 hours
Module 6	Fundamental of Research-Research Methodology and Project Management	6 hours
Module 7	Application of Geo-Informatics and Spatial Decision Support System	4hours
Module 8	Generation of Case Studies(Compulsory Field study)	4 hours
Module 9	Environmental Monitoring and Assessment- QGIS Customization Using Python	4 hours
Module 10	Customization of Geospatial Tools-GIS Customization Using ArcGIS	4 hours
Text Book(s)		
1	George Joseph and C Jeganathan, Fundamentals of Remote Sensing,3 rd Edition, January 2018	
2	Lillesand , Kiefer, Chipman ,Remote Sensing and Image Interpretation, 6 th Edition, January 2011	
3	BasudebBhatta, Remote Sensing and GIS, 2 nd Edition, August 2011	
Related Online Contents		
1	https://onlinecourses.nptel.ac.in/noc19_ce41/preview	
2	https://www.coursera.org/lecture/spatial-analysis-satellite-imagery-in-a-gis/what-is-remote-sensing-27nfo	
3	https://gisgeography.com/remote-sensing-earth-observation-guide/	

Online Course

Course code	20CSOL1	R-Programming	L	T	P	C
Online		Online	2	0	0	2
Pre-requisite		Fundamentals of Database management and Data Mining	Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are:						
1. To provide in depth knowledge about the basics of R, decision making and looping statements.						
2. To discuss the R data structures.						
3. To inculcate visualization and basic machine learning techniques.						
Expected Course Outcomes:						

On the successful completion of the course, student will be able to:		
1	Understand the basics of R, data types and variables. Write programs using decision making and looping statements. Know how to create functions and strings.	K2/K3
2	Analyze the use of different R data structures, packages and input/output features.	K2/K3/K4
3	Apply the different data visualization methods.	K2/K3
4	Createthe data sets in the formats like CSV, excel, binary, XML and JSON files and able to perform data analysis.	K2/K3/K6
5	Analyze the datasets using supervised and unsupervised algorithms	K3/K4/K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		
Unit:1	Introduction	8 hours
Downloading and Installing Rand RStudio – History and Overview of R – Definition – Data Types - Variables – Keywords - Operators - Decision Making Statements – Looping Statements - Functions - Strings.		
Unit:2	Data Structures	8 hours
Vectors – Lists – Matrices - Arrays – Factors – Data Frames – R Packages – List of Packages - Input and Output Features.		
Unit:3	Data Visualization	4 hours
Pie Chart –Bar Chart- Box Plots – Histograms – Line Graphs – Scatter Plots.		
Unit:4	Data Interfaces	5 hours
Importing data - CSV files – Excel file – Binary Files – XML Files – JSON File – Web Data - Exporting Data –Viewing Data - R Database – Data Cleaning: Missing Values - Zeros and NAs – Separating – Uniting Columns.		
Unit:5	Machine Learning	4 hours
Supervised Learning - Classification – Regression –Unsupervised Learning: Clustering.		
Unit:6	Contemporary Issues	1 hours
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	30 hours
Text Book(s)		
1	Norman Matloff, “The Art of R Programming A Tour of Statistical Software Design”, William Pollock, 2011.	
2	Emmanuel Paradis, “R for Beginners”, Institutes Sciences de l’Evolution, 2005.	
Reference Books		
1	Roger D. Peng, “R Programming for Data Science”, Lean Publishing, 2015	
2	Scott V. Burger, “Introduction to Machine Learning with R Rigorous Mathematical	

	Analysis”, O’Reilly Media, 2018
3	Brett Lantz, “Machine Learning with R”, Packt Publishing, 2013
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/learn/r-programming
2	https://www.udemy.com/topic/r-programming-language/
3	https://online-learning.harvard.edu/subject/r
4	https://www.datacamp.com/courses/free-introduction-to-r
5	http://ijsetr.org/wp-content/uploads/2015/04/IJSETR-VOL-4-ISSUE-4-816-820.pdf
6	https://www.ijcait.com/IJCAIT/21/213.pdf
7	https://www.igi-global.com/chapter/promoting-business-activities-using-utility-mining-techniques/198707
Course Designed By: Dr. S. Vijayarani	

Mapping with programme outcomes:

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

S- Strong; M-Medium; L-Low