

SEMESTER I

Year	I	CourseCode:	Credits	4
Semester	I	CourseTitle:DigitalLogicFundamentals	Hours	45
			Category	C
Course Prerequisites, ifany	BasicknowledgeofComputers			
Course Outcomes	- Understandanddescribetheprinciplesofdigitalsystemsandbinary number operations - ApplyKarnaughmappingtosimplifyBooleanexpressionsandoptimize digital circuits - Analyzeanddesignbasiccombinationalcircuitsusingvariousdigital components - Synthesizeandevaluatesynchronoussequentialcircuitsusingstorage elements and HDL - DesignandimplementvarioustypesofregistersandcountersusingHDL			
UnitNo.	CourseContent		Hours	
TheoryComponent				
UnitI	DigitalSystemsandBinaryNumbers DigitalSystems–BinaryNumbers–Number-BaseConversions– Octal and Hexadecimal Numbers – Complements of Numbers – Signed Binary Numbers – Binary Codes – Binary Storage and Registers – Binary Logic – Axiomatic Definition of Boolean Algebra – Basic Theorems and Properties of Boolean Algebra – Boolean Functions – CanonicalandStandardForms– OtherLogicOperations–DigitalLogic Gates–IntegratedCircuits		9	
UnitII	Gate-LevelMinimization MapMethod–Four-VariableK-Map– Product-of-SumsSimplification – Don’t-Care Conditions – NAND and NOR Implementation – Other Two-Level Implementations – Exclusive-OR Function – Hardware Description Language		9	
UnitIII	CombinationalLogic Analysis Procedure–DesignProcedure–Binary Adder–Subtractor– DecimalAdder– BinaryMultiplier–MagnitudeComparator–Decoders –Encoders–Multiplexers–HDLModelsofCombinationalCircuits		9	
UnitIV	SynchronousSequentialLogic Storage Elements – Latches – Flip-Flops – Analysis of Clocked Sequential Circuits - Synthesizable HDL Models of Sequential Circuits – State Reduction and Assignment – Design Procedure		9	
UnitV	RegistersandCounters Registers – Shift Registers – Ripple Counters – Synchronous Counters – Other Counters – HDL for Registers and Counters		9	
RecommendedLearningResources				

Text Books	1. M.MorrisMano,MichaelD.Ciletti,“Digitaldesignwithanintroduction to the Verilog HDL”, Pearson, Sixth Edition, 2018.
Reference Books	1. M.Rafiquzzaman,“FundamentalsofDigitalLogicandMicrocomputer Design”, John Wiley & Sons, Inc., Fifth Edition, 2009

Practical Component		
Title of the Practical: DigitalLogicFundamentals		
Ex. No	Exercises	Hours
1	BinarytoDecimalandvice-versa	30
2	DecimaltoHexadecimalandVice-Versa	
3	DigitalLogicGates	
4	SimplificationofBooleanFunctions	
5	CombinationalLogicCircuits i. CodeConverters ii. Arithmetic (Adders, Subtractors,Multipliers, Comparators) iii. DataHandling(Multiplexers, Demultiplexers, Encoders &Decoders)	
6	CombinationalLogicCircuitDesign	
7	BinaryAdder-SubtractorSimulation	
8	DecimalAdderSimulation	
9	BinaryMultiplierSimulation	
10	SequentialCircuitStorageElements:Flip-FlopSimulation	
Tools/Software to be used		Digital Trainer Kit, Simulator - LogiSim

Year	I	CourseCode:	Credits	4
Sem.	I		Hours	45
		CourseTitle:ITEssentials-MID-1	Category	C
Course Prerequisites,if Any	BasicKnowledgeofComputersandMobileDevices			
Course Outcomes	- UnderstandthecomponentsofITinfrastructureandconfigure them - LearntoInstallandconfigureproprietaryandopen-sourceOperatingSystems - Designaninfrastructuredeploymentasperspecifiedrequirements - Applythe basic knowledgeofITinfrastructure forcreatingnew deployments - AnalyzethefunctionsofITinfrastructuretooptimizethem			
UnitNo.	CourseContent			Hours
TheoryComponent				
UnitI	ITConceptsand Infrastructure Understanding Motherboards- Processors-Memory- Cooling System-Configuring Expansion Cards- Storage Devices- Power Supplies- Peripheral, Cables, and Connectors - Printers and Multifunction Devices -Installing and Maintaining Printers			9
UnitII	OperatingSystemsandApplications Operating Systems, Terms and Concepts- System Requirements- Applications-Installation- Security Concerns- Introduction to Windows 10- Windows Configuration- Interacting with OS- Windows Registry-DiskManagement - WindowsAdministration-Installingand UpgradingWindows- Commandlinetools-WorkingwithLinux-Basic Linux Commands- Linux and Windows			9
UnitIII	NetworkingConcepts Networking Principles- Identifying Common Network Hardware- Network Introduction to TCP/IP - Understanding TCP/IP- Understanding Virtual Networks			9
UnitIV	WirelessNetworksandNetworkServices Wireless and SOHO Networks- Understanding Wireless Networking Technologies - Installing and Configuring SOHO Networks - Network Services and Cloud Computing- Understanding Network Services- Understanding Cloud Computing- Concepts of Cloud Computing			9
UnitV	MobileDevicesandConnectivity Working with Laptop and Mobile Device Hardware- Differences between Device Types- Disassembling and Reassembling Laptops- Installing and Configuring Laptop Hardware- Setting Up and Configuring Accessories and Ports - Mobile Connectivity and Application Support - Understanding Mobile Connectivity- Understanding Mobile App Support			9

Practical Component

Exercises	1. Demonstratingdisassemblingacomputer,explainingits various parts, and reassembling it 2. Installingprinteranddemonstratingsuccessfulprintingof documents 3. Demonstratingtheinstallationandconfigurationofthe Windows operating system 4. DemonstratingtheuseofvariousWindowscommand-line functions 5. DemonstratingtheinstallationoftheLinuxoperatingsystem 6. DemonstratingtheuseofbasicLinuxcommands 7. Performing study of various networking hardware - routers, switches, etc. 8. Demonstrating the installation and configuration of routers, switches, etc. 9. DemonstratingthecreationofaSOHOnetworkandconfiguring the same 10. Creatinganaccountinanycloudserviceprovider 11. Demonstrating the creation of infrastructure as a service by creating suitable computing configuration in the cloud 12. Demonstrating the disassembling of laptops, explaining their parts and reassembling of laptops 13. Demonstratingthedisassemblingofamobilephone, explainingitsparts,andreassemblingit	30
RecommendedLearningResources		
PrintResources	Text Books: 1. Quentin Docter, Jon Buhagiar, “CompTia A+ COMPLETE study GUIDE”, core 1exam 220-1101 and core 2 exam 220-1102, Wiley Sybex Publication, 2022. 2. MikeMeyers,“CompTIAA+CertificationAll-in-OneExamGuide”,Tenth Edition(Exams220-1001&220-1002),McGraw-HillEducation,2019.	
Tools Used:	1. NETLAB+ 2. Trainer Board to demonstrate Assembling and Working of Multimedia Computer System 3. Trainer Boards to Study Mother Boards with different chipsets and processors. 4. Hard disk Trainer board (SATA and IDE) 5. Trainer Board to study working of Dot matrix printer, Inkjet printer & Color Laser printer 6. Display Boards of various types of cables & connectors used in Computer networks.	

Year	I	CourseCode:	Credits	3
Semester	I	CourseTitle:PythonProgramming	Hours	60
			Category	B
Course Prerequisites, if any	BasicKnowledgeof Programming			
Course Outcomes	- UnderstandthebasicsofwritingPython code - Implementprogramsusinglists,tuplesanddictionaries - Understandtheuseofcontrol structures - Abilitytowriteprogramsusingpackages - Understandthefilemanipulation			
Practical Component				
Ex. No	Exercises			Hours
1	Exchangethevaluesoftwovariables			30
2	Findingminimumamongnvariables			
3	PerformSimplesorting			
4	GenerateStudents'marksstatement			
5	Findsquareroot,GCD,exponentiation			
6	Sum thearrayofnumbers			
7	Performlinearsearch,binarysearch			
8	PerformMatrixoperationsusingNumPy			
9	(a) PerformDataframeoperationsusingPandas. (b) UseMatplotlibonthedatasetandvisualize			
10	PerformWordcount,copyfileoperations			
Tools/Software to be used		Python 3		

The above exercises are designed based on:

Python Basics: Variables, Data Types, Operators, Input and Output, Control Statements, Functions, Arrays, Searching Techniques (Linear Search, Binary Search), Sorting Techniques, Mathematical Functions (Square Root, GCD, Exponentiation), File Handling, Word Count, File Copy Operations.

NumPy: Array Creation, Matrix Operations, Mathematical Operations, Indexing and Slicing, Numerical Computation.

Pandas: Series, DataFrames, Data Manipulation, Data Analysis, Indexing, Dataframe Operations.

Matplotlib: Data Visualization, Plotting Graphs, Charts, Dataset Visualization, Figure Customization.

Recommended Learning Resources	
Text Books	1. MarkLutz,“LearningPython”,FifthEdition,O’Reilly,2013. 2. DanielLiang,“IntroductiontoprogrammingusingPython”,Pearson,Firstedition,2021. 3. WesMcKinney,“PythonforDataAnalysis”,O’ReillyMedia,2012.
ReferenceBooks	1. TimHallandJ-PStacey,“Python3forAbsoluteBeginners”,Apress,FirstEdition, 2009. 2. Magnus Lie Hetland, “Beginning Python: From Novice to Professional”, Apress, Second Edition, 2005.

SEMESTER II

Year	I	CourseCode:	Credits	4
Semester	II	CourseTitle:ProblemSolving and Programming Fundamentalsusing ‘C’	Hours	75
			Category	C
Course Prerequisites, ifany	NIL			
Course Outcomes	- Analyzeproblemsanddeveloptop-down designs. - Write,compile, anddebugbasicprograms. - Implementlogicwithconditionalsandloops, manipulating arrays and strings. - DesignandimplementFunctions, Structure and Union. - Understand the concepts of Pointers and File handling.			
Unit No.	CourseContent		Hours	
TheoryComponent				
UnitI	IntroductiontoComputerProblem-Solving: Problem solving Aspect – Top-down Design– ImplementationofAlgorithms–ProgramVerification– EfficiencyofAlgorithms–AnalysisofAlgorithms- Basic Data types – Variables – Expressions – I/O statements – Compile and Run – Debugging		9	
UnitII	DecisionMaking–Branching&Looping: Decision making – Relational Operators – Conditional statement, Looping Statements – Nested loops – Infinite loops – Switch Statements		9	
UnitIII	ArrayTechniques & Functions: Array Manipulation- Different operations– One dimensionalArray– Two-dimensionalArray–Multi- dimensionalArray–Character– ArraysandStrings - Introduction to Functions – Importance of Design of Functions – Arguments – Parameters – Return Values – Local and Global Scope – Recursion		9	
UnitIV	Structure & Pointers: Defining and processing - Structure initialization –Array of Structures – Array with in a Structures – Passing to a function - Union- Declarations and initialization of pointer variables, Passing to a function – Pointer of arrays – Array of Pointers - Pointer to Functions.		9	
UnitV	File Handling & Pre-Processor: Files: Create, Open, Close Files – Process unformatted data Files – Pre –Processor: Macro and its type – Command Line Arguments: Defining and using command Line Arguments. Dynamic Memory Allocation.		9	
RecommendedLearningResources				

Text Books	1. R.G.Dromey, “HowtoSolveitbyComputer”, PearsonEducationIndia, ThirteenthEdition, 2013. (Unit I) 2. E. E. Balagurusamy, “Programming in ANSI C”, 8th Edition Tata McGraw Hill, 2019. (Unit II to V)
Reference Books	1. P. K. Sinha & Priti Sinha, “Computer Fundamentals”, BPB Publications, 2007. 2. Byron S. Gottfried, “Programming with C”, Schaum’s Outline Series, TMH, 4th Edition 2018.

Practical Component		
Title of the Practical: ProblemSolving&ProgrammingFundamentals using ‘C’		
Ex. No	Exercises	Hours
1	Programtoexchangethevaluesoftwovariableswithoutusing a third variable	30
2	Programthattakes an integerasinputand reversesits digits	
3	Program to compute sum of N numbers using loop	
4	Program to generate the Fibonacci sequence up to a specified limit	
5	Program to implement control structures	
6	Programtoarraycounting,arrayorderreversal&findthe maximum & minimum number in a set	
7	Program that takes a list of numbers as input and counts the total number of elements in the list	
8	Program to implement String Manipulation	
9	Program to compute the sine of an angle (in degrees) using aseries expansion using function	
10	Programtocomputethefactorialusing recursion	
11	Program to display a student mark statement using structure	
12	Program to process an employee payroll using structure	
13	Program to swap to two numbers using pointers	
14	Program to read, write, open, copy a file	
15	Program to read a Command Line argument and print the output	
Tools/Software to be used		TURBO C

Year	I	CourseCode: CourseTitle:PC,NetworkandMobileDevice Troubleshooting-MID2	Credits	4
Sem.	II		Hours	45
			Category	C
Course Prerequisites	● Basicknowledgeofusingcomputers,internetandmobiledevices			
Course Outcomes	● UnderstandthecommonhardwareandsoftwareissuesinPCs, networks, and mobile devices ● LearntheprinciplesoftroubleshootinginPCs,Operatingsystem, networks, and mobile devices ● Applydiagnostictoolsandtechniquestoidentifyandresolvehardware and software problems on PCs, networks, and mobile devices ● Evaluatethesecurityimplicationsofvarioustroubleshootingactionson PCs, networks, and mobile devices			
UnitNo.	CourseContent			Hours
TheoryComponent				
UnitI	Troubleshooting Methodology and Resolving Core Hardware Problems UsingtheTroubleshootingBestPracticeMethodology,Troubleshooting Motherboards, CPUs, RAM, and Power Problems, Troubleshooting Storage Devices andRAID Arrays, Troubleshooting Video, Projector, and Display Issues, Troubleshooting Printers Problems, Troubleshooting Common Mobile Device Issues.			9
UnitII	SecurityIssuesforTroubleshooting Security Concepts - Physical Security Concepts, Physical Security for Staff, Logical Security, Malware, Mitigating Software Threats, Social Engineering Attacks, Threats and Vulnerabilities, Common Security Threats, Security Best Practices, Best Practices for Malware Removal.			9
UnitIII	NetworkTroubleshooting Troubleshooting Networking Problems -Using Network Troubleshooting Tools, Resolving Connectivity Issues, Repairing Physical Cabling, Fixing Common Problems, Troubleshooting Wi-Fi-Hardware Troubleshooting, Software Troubleshooting, Connectivity Troubleshooting, Configuring Troubleshooting, securing a SOHO Network (Wireless), Securing a SOHO Network (Wired).			9
UnitIV	TroubleshootingOperatingSystem TroubleshootingCommonOSProblems-CommonSymptoms,Common Troubleshooting Steps, Troubleshooting Security Issues - Common Symptoms, Browser Related Symptoms, Working with Windows OS Security Settings-Users and Groups, User Authentication, NTFS vs. Share Permissions, Shared Files and Folders, System Files and Folders, WindowsSecurityFeatures.			9

Unit V	Mobile Device Troubleshooting Mobile Device Security, Troubleshooting Mobile OS Issues-Application Problems Performance Issues, OS Fails to Update Extremely Short Battery Life, Connectivity Issues, Auto Rotate Issues, Troubleshooting Mobile Security Issues-Security Concerns, Common Symptoms.	9
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Exercises	1. Demonstrating the troubleshooting of motherboards, CPUs, RAM, power problems, Storage Devices 2. Demonstrating the troubleshooting of RAID Arrays, Video, Projector, and Display Issues 3. Demonstrating the troubleshooting of Printer Problems, Common Mobile Device Issues 4. Demonstrating the mitigation of common security threats using appropriate software 5. Demonstrating the troubleshooting of Networking Problems using Network Troubleshooting Tools 6. Demonstrating the troubleshooting of Resolving Connectivity Issues, Repairing Physical Cabling, Fixing Common Problems 7. Demonstrating the troubleshooting of Wi-Fi- Hardware Troubleshooting, Software Troubleshooting 8. Demonstrating troubleshooting Common OS Problems Troubleshooting Security Issues, Browser issues 9. Working with Windows OS Security Settings, Creating Users and Groups, setting up user Authentication, creating NTFS vs. Share file Permissions 10. Configuring Windows Security Features. 11. Demonstrating troubleshooting of Mobile OS Issues, Application Problems, Performance Issues 12. Demonstrating troubleshooting of OS Update failure, Extremely Short Battery Life, Connectivity Issues, Auto Rotate Issues, Mobile Security Issues	30
Recommended Learning Resources		
Print Resources	Text Books: 1. Quentin Docter, Jon Buhagiar, "COMPTIAA+COMPLETE study GUIDE", (core 1 exam 220-1101 and core 2 exam 220-1102), WILEY-SYBEX, 2022. 2. Meyers, "CompTIAA+ Certification All-in-One Exam Guide", Tenth Edition (Exams 220-1001 & 220-1002), McGraw-Hill Education 2019.	

Year	I	CourseCode:	Credits	3
Semester	II	CourseTitle: Visual Programming with c#	Hours	60
			Category	B
Course Prerequisites , if any	BasicKnowledgeof Programming			
Course Outcomes	- Understandthekeycomponentsofthe.NETFrameworkrelatedtoC# development - LearnthebasicsyntaxandstructureofC# programs - DesignC#applicationsbyintegratingvariousobject-orientedprogramming techniques in the .NET framework - Analyzethesignificanceofgraphicaluserinterface(GUI)componentsand the Event Handling Model using C# programming - Learnandapplythefundamentalskillstoefficientlydevelop,test,and deploy ASP.Net Core applications			
Practical Component				
Title of the Practical:				
Ex. No	Exercises			Hours
1	Installation of Visual Studio and creation of Simple Console Application			30
2	CreateasimpleC#programforthefollowingconcepts: - To Check whether a given number is an Armstrong or not - ToCheckwhetherthealphabetisa vowel ornot using switch case - To Checkwhetherthegivenstringispalindromeor not using arrays			
3	Create a program to demonstrate boxing and unboxing operations			
4	Implement the basic OOP concepts			
5	ImplementInterfacesandOperatorOverloading			
6	CreateaGUIusingstandardcontrols,SDI&MDIforms			
7	DesignanapplicationwithmenuoptionsandaCommon Dialog box			
8	createasimplewebapplicationusingASP.Net			
9	DevelopanyONEcasestudylistedbelow: - InventoryControl - RetailShopManagement - EmployeeInformationSystem - PersonalAssistantProgram - Students’InformationSystem			
Tools/Software to be used		Microsoft Visual Studio 2010 Professional Edition (OR) Microsoft Visual Studio 2008 Professional Edition		

The above exercises are designed based on the following concepts:

.NetFramework: Framework Components - The Common Language Runtime (CLR) - .NET Base Class Library - Common Language Specification (CLS) - Common Type System (CTS) - Metadata and Assemblies - .NET Namespaces - MSIL - JIT Compilers

Program Structure ofC#: Data Types- Operators-Statements and Expressions- Branching- Looping and loop controlstatements-Arrays-Stringsmanipulation-BoxingandUnboxing- Pre-processors-Namespaces

ObjectOrientedProgrammingconcepts inC#: Class- Objects- Encapsulation- Constructors and its types- Inheritance- Polymorphism-Interface-Abstractclass- Operatoroverloading-Properties-Indexers- Delegates-Collections

WindowsForms: Windows Forms and various controls-SDI and MDI applications- Menu Creation, Common Dialog Boxes- Events and event handling

ASP.Net: ASP.NET Core project, ASP.NET Core application.

SEMESTER III

Year	II	Course code:	Credits	4
Semester	III	Course Title: Object Oriented Programming using ‘JAVA’	Hours	75
			Category	C
Course Prerequisites		Knowledge in Programming Concepts		
Course Outcomes		• To understand the concepts of Object Oriented Programming • To learn the multi-threading programming • To learn the GUI Programming structure • To learn about database programming • To analyze various File System methods and Disk scheduling algorithms • To implement Files and Streams		
Theory Component				
Unit-No		Content	Hours	
Unit-I		Basic concepts of OOPS, Java Features, Objects and Classes, Accessing Class Members, Data types, Types of Operators, Control statements – Arrays Strings – String Buffer Classes – Wrapper Classes - Constructor & Methods- Types of Constructors – Overloading & overriding	9	
Unit-II		Inheritance – Types of Inheritance – Final Keyword - Interface – package – Accessing Package - Introduction to Multithreading – Life cycle of Thread, Thread Methods	9	
Unit-III		Exception Handling – Try and catch – throws and finally statement , Files, Streams & Object Serialization – Introduction – Files & Streams – Sequential Access Text Files.	9	
Unit-IV		GUI components – Introduction – Overview of Swing components – Swing vs AWT – AWT Controls, Container, Introduction to Event Handling with Nested Classes - Common GUI Event Types and Listener Interfaces - How Event Handling Works – various Event Handling – Layout Manager	9	
Unit-V		Applets & Java Web Start – Applet Life-Cycle – Graphics class & Methods – Java web start & Java Network Launch Protocol (JNLP) – JDBC Architecture, Types of JDBC Drivers, Accessing databases with java database connectivity (JDBC)	9	

Recommended Learning Resources	
Text Books	1. Herbert Schildt, "C#4.0: The Complete Reference", First Edition, McGraw Hill Education, 2017. 2. Albahari, J., "C#10 in a Nutshell: The Definitive Reference", First Edition, O'Reilly, 2022. 3. Adam Freeman, A., "Pro ASP.NET Core 7", Tenth Edition, Manning Publications, 2023.

Recommended Learning Resources	
Text Books	1. Java: The Complete Reference, 11 th Edition, Herbert Schildt, McGraw-Hill Publication, Dec 2018, 2. Programming with Java, 7 th Edition, E. Balagurusamy', McGraw Hill Publication
Reference Books	1. Java 2 Programming: Black Book, Steven Holzner, Dreamtech Press 2015 2. Advanced Java Concepts and Implementation, A.A. Puntambekar, Technical Publications, 2021

Practical Component		
Title of the Practical: Object Oriented Programming using JAVA		
Ex. No	Exercises	Hours
1	Write a program to implement different control structures	15
2	Write a program to implement String and String Buffer Classes	
3	Write a program using Wrapper class.	
4	Write a program to implement different types of constructors.	
5	Write a program to implement inheritance concepts	
6	Write a program to implement multiple inheritance using interface concepts	
7	Write a program to demonstrate exception handling.	
8	Write a programs to implement multi threading	
9	Write a program to implement packages in java	
10	Write a program to design GUI using different AWT controls.	
11	Write a program to create menu bar with various menu items and sub menu items.	
12	Write a program to design GUI using layout manager	
13	Write a program to design a calculator in grid layout using swing components	
14	Write a program to implement database connectivity using JDBC	
Tools/Software to be used		JDK 1.8, MySQL, Oracle

Year	II	Course code:	Credits	4
Semester	III	Course Title: Data Structures	Hours	75
			Category	C
Course Prerequisites		Introductory Knowledge about computing		
Course Outcomes		• Learn basic concepts of and Data structures and algorithms using searching and sorting techniques • Understand the concept of polynomial addition and sparse matrices using arrays. • Apply linked lists to solve problems related to stacks, queues, and sparse matrices. • Understand the operations and traversals of binary trees. • Apply graph algorithms to solve problems like topological sorting & finding minimum cost spanning trees.		
Theory Component				
Unit-No	Content		Hours	
Unit-I	Introduction Data Structures: Basic Terminologies – Linear and Nonlinear Data Structures – Algorithm: Properties – Analyzing algorithms. Searching Techniques: Linear search, Binary Search, Fibonacci search. Sorting techniques: Selection Sort, Bubble Sort, Quick Sort, Insertion Sort, Heap Sort and Merge Sort.		11	
Unit-II	Arrays, Stacks and Queues Arrays: Representation – Polynomial Addition – Sparse Matrices - Multidimensional Arrays. Stacks: Stack ADT - Operations – Applications - Evaluation of Expressions. Queues: Queue ADT - Operations – Applications – Multiple Stacks and Queues.		9	
Unit-III	Lists Singly Linked Lists – Linked Stacks and Queues – Operations - Circularly Linked Lists – Equivalence Relations – Sparse Matrices - Doubly Linked Lists.		9	
Unit-IV	Trees Tree: Basic Terminologies - Binary trees – Representation – operations – Traversals, Types - Applications of Trees – AVL trees.		7	
Unit-V	Graphs Graph: Basic Terminologies – Representation – Operations - Traversals – Applications - Spanning trees, Shortest path Problem, Transitive closure, Topological sort.		9	
Recommended Learning Resources				
	1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.			

Text Books	
Reference Books	2. D. Samanta, Classic Data Structures, Second Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012. Computer Organization — Carl Hamacher et al. 3. Richard Gilberg, Behrouz and A. Forouzan, “Data Structures: A Pseudocode Approach with C”, Second edition, India Edition 2005.

Practical Component		
Title of the Practical: Data Structures		
Ex. No	Exercises	Hours
1.	Search Algorithms (with the number of key comparisons) – Sequential, Binary and Fibonacci search algorithms	30
2.	Evaluation of arithmetic expression	
3.	Stack, Queue, Circular Queue, priority queue	
4.	Singly Linked List, Doubly Linked List, Circular Linked List	
5.	Tree Traversal Techniques	
6.	Graph Traversal Techniques	
7.	Dijkstra’s Algorithm to obtain shortest paths	
Tools/Software to be used		C / Python

Year	II	CourseCode: CourseTitle:DATA ANALYSIS TECHNIQUES	Credits	4
Sem.	III		Hours	75
			Category	C
Course Prerequisites, if any	BasicunderstandingofComputers			

Course Outcomes	• Understand the statistics and scientific methods for data analysis • Understand the data collection methods • Explain the ways of summarizing the data. • Using the various excel formulas • Generate reports using formulas	
Unit No.	Course Content	Hours
Theory Component		
Unit I	Introduction Statistics and scientific methods, why study statistics? Current applications of statistics, Types of data, Data analysis as a process, Data Analysis as a cycle, Ways of analyzing qualitative data and quantitative data.	9
Unit II	Data Collection Using surveys and experimental studies to gather data - Introduction to abstract research study - observational studies - Sampling designs for survey - Experimental Studies - Designs for experimental studies - Research study.	9
Unit III	Data Summarizing Data description - Introduction and abstract of research study - Calculators, Computers and software systems - Describing data on a single variable - Graphical methods, measures of central tendency - measures of variability - summarizing data from more than one variable	9
Unit IV	Statistical Measures Statistical measures – Mean, Variance, Percentiles, Quartiles - Pearson correlation – Spearman's Rank correlation – Parametric tests – test for single population mean, equality of mean for two independent sample, paired t test, testing correlation coefficient, Non parametric tests – Mann Whitney U test, Wilcoxon signed rank test – Kruskal Wallis test – One way ANOVA – Simple and Multiple Linear regression	9
Unit V	Macros VBA Macro - Introduction to VBA Macro - Recording Macro & Understanding Code Behind - Editing, Writing VBA Code and Saving as Macro.	9

	PracticalComponent	
List of Exercises	1. Write a python script to read and writecsv and excel file file usingpython 2. Writeapythonscripttofindthestatisticalparameters ofthedataset 3. Identifythewaysofdatacollectionusing python 4. Implementthedifferenttypesofstudiesusingpython 5. Writeapythonscript findthemeasuresofcentra ltendencyand measures of variability 6. Performdatasummarizationusing python 7. Compute mean ,variance, percentiles, Pearson correlation for data set using python 8. ImplementthecreationofANOVAtable 9. ImplementVBAmacroandrecording macro 10. Editingandwritingamacrocode	30
RecommendedLearningResources		
Print Resources	TEXTBOOK: 1. R.LymanOtt(2022),<i>AnIntroductiontoStatisticalMethodsandData Analysis</i>7thEdition,CengageLearning,Inc REFERENCEBOOK: WayneL. Winston(2011),<i>MicrosoftExcel2010DataAnalysisandBusiness</i> 1. <i>Modeling</i>,MicrosoftPresspublisher EBooks: https://spreadsheetplanet.com/best-excel-books/	

Year: II	Course code:		Credits	4
Semester: III	Course Title:	SEC 3 - Desktop Publishing	Hours	45
			Category	C
Course Prerequisites	Basic computer knowledge			
Course Outcomes	- To understand the fundamentals of Desktop Publishing, its applications in media, advertising, and printing. - To create and format professional documents using Adobe PageMaker / AdobeInDesign, including the use of master pages, templates, styles, text, and images. - To design brochures, flyers, newsletters, posters, banners, and logos using CorelDRAW, applying vector drawing tools, colors, fills, and outlines. - To edit, retouch, and enhance images using Adobe Photoshop by working with layers, masks, filters, text effects, and optimized file formats. - To demonstrate knowledge of printing and production workflows, including prepress and postpress processes, proofing, quality control, and packaging files for printers.			

Practical Component		
Ex.No	Exercises	Hours
1.	Identify DTP applications, page layout elements, typography features, color models, and raster vs vector graphics.	30
2.	Create a sample document demonstrating fonts, alignment, spacing, columns, and color usage.	
3.	Create and format a multi-page document with margins, columns, and guides.	
4.	Insert, format, and align text and images; apply text wrapping.	
5.	Design master pages with headers, footers, page numbers, and apply paragraph/character styles.	
6.	Design a professional flyer or brochure using PageMaker/InDesign.	
7.	Create vector objects using drawing tools, shapes, and curves.	
8.	Apply solid fills, gradients, outlines, and color palettes to objects.	
9.	Design a simple logo using vector tools and text effects.	
10.	Create a poster or banner for an event or product.	
11.	Prepare a document with proper resolution, bleed, crop marks, and CMYK color mode.	
12.	Design a complete print product and package all files for printing with quality checks.	
Tools/Software to be used		Adobe PageMaker, CorelDRAW, Adobe Photoshop

The above exercises are designed based on the following topics:

Applications of DTP: in media, advertising, and printing-Understanding page layout, typography, and color theory-Raster vs vector graphics.

Adobe PageMaker / InDesign: Workspace and tools-Creating and formatting documents-Master pages, templates, styles- Working with text and images-Creating brochures, flyers, newsletters.

CorelDRAW

Vector graphics-Drawing tools, shapes, curves-Working with colors, fills, outlines-Logo design, posters, banners-Exporting and printing options

Printing

Prepress and postpress processes-Resolution, bleed, crop marks, color modes - RGB/CMYK)-Preparing documents for print-Proofing and quality control-Packaging files for printers

Year	II	CourseCode:	Credits	3
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Semester	III	CourseTitle:R Programming	Hours	60
			Category	B
Course Prerequisites, if any	Basic Computer Knowledge			
Course Outcomes	• Learn the basics in R programming • Understand to accessing variables and managing subsets of data • Design simple applications using the functions of R programming • Analyze the performance of the plotting tools in R programming • Create a project using the Lattice Package in R programming			

Ex. No	Practical Component	Hours
1	Install R and RStudio, create and execute your first R script, generate basic plots using both base R and ggplot2, install and utilize R packages, and import and explore a dataset	30
2	Access specific variables from a data frame and manage subsets of data	
3	Combine two datasets with a common identifier and export your final data set	
4	Read data, explore structure using head(), summary(), and str()	
5	Handle missing values, remove duplicates with duplicated()	
6	Create plots (scatter, line, bar) using ggplot2	
7	Create plots (pie, bar and strip chart, boxplot, Cleveland dotplots, pairplot, coplot) and a composite plot that combines multiple plot types, using R's graphing capabilities	
8	Create advanced visualizations (multipanel scatterplots, boxplots, Cleveland dotplots, histograms, panel functions) using lattice functions in R	
9	Create 3-D scatterplots and surface and contour plots to explore complex data relationships	
Tools/Software to be used		

The above exercises are designed based on following concepts:

Installing R – Script code – Graphing Facilities in R – Packages – General Issues in R – Getting Data into R – Importing Data

Accessing variables from a Data Frame: – Accessing Subsets of Data – Combining Two Datasets with a Common Identifier – Exporting Data – Recoding Categorical Variables

Simple Functions: The tapply Function – The sapply and lapply Functions – The summary Function – The table Function

Plotting Tools: The plot Function – Symbols, Colours, and Sizes – Adding a Smoothing Line – Loops and Functions

Graphing Tools: Pie Chart – Bar Chart and Strip Chart – Boxplot – Cleveland Dotplots – Pairplot – Coplot – Combining Types of Plots

Lattice Package: High-level Lattice Functions – Multipanel Scatterplots – Multipanel Boxplots – Multipanel Cleveland Dotplots – Multipanel Histograms – Panel Functions – 3-D Scatterplots and Surface and Contour Plots

Recommended Learning Resources	
Text Books	4. Alain F. Zuur, “A Beginner’s Guide to R”, Springer-Verlag New York Inc., 2019. 5. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R”, Amazon Digital South Asia Services Inc, Revised Edition, 2014.

Year	II	CourseCode:	Credits	4
Sem.	II		Hours	75
			CourseTitle:DATAVISUALIZATION	Category
Course Prerequisites, if any	BasicunderstandingofComputers			
Course Outcomes	• UnderstandtheconceptsofDatavisualization. • Understandtheprocessofbuildingeffectivevisualization • ApplythePythonLibrariestobuildVisualization • Analyzevariousvisualizationoptionstobuildoptimalvisualization. • Createeffectivevisualization.			
UnitNo.	CourseContent		Hours	
Theory Component				
UnitI	Introduction Introduction to Data Visualization – Definition – Use ofData Visualization – Elements of Data Visualization – Importance of Data Visualization.		9	
UnitII	VisualizationBasics The power of visual storytelling – Good Examples of Data visualization – Benefits. - Different types of charts and graphs used in Data visualization – Selecting right data visualization elements – Grouping – Software tools and libraries for Data visualization.		9	
UnitIII	Matplotlib Introduction to Matplotlib – Plotting functions – subplot functions – coloring – Building line plots – Bar plots – Scatter plots – Histogram – Pie charts.		9	
UnitIV	Pandasbasedplotting Pandasforplotting–Variousplotswithpandasdata– A case study with pandas based plotting.		9	
UnitV	Seaborn Seabornforvisualization–Features–Benefits–Plotting with seaborn – Categorical data plotting with seaborn – Case studies using seaborn.		9	

	PracticalComponent	
List of Exercises	1. Buildalineplotusing Matplotlib. 2. BuildaPiechartusing MatplotLib. 3. BuildhistogramusingMatplotlib. 4. Customizethechartsbuiltintheaboveexercises with various options. 5. Buildavisualizationwithsourcedatahandling using Pandas. 6. Buildany3typesofchartsusingseaborn. 7. PerformCategoricaldataplottingwithseaborn. 8. CaseStudy:Populationgrowthplotting 9. CaseStudy:HappinessIndexacrossvarious countries - an analysis. 10. Developavisualizationwithmultiple subplots.	30
RecommendedLearningResources		
Print Resources	TEXTBOOK: 1. KalilurRahmman,PythonDataVisualizationEssentialsGuide,BPBpublications, First Edition (2021), ISBN: 978-93-91030070. REFERENCEBOOK: 1. ColeNussbaumerKnafllic,StorytellingWithData:ADataVisualizationGuideFor Business Professionals, Wiley publications , (2015), ISBN:978-1119002253	

SEMESTER- IV

Year	II	Course code:	Credits	4
Semester	IV	Course Title: Database Management Systems	Hours	75
			Category	C
Course Prerequisites		Knowledge of Data Structures and File-Handling		
Course Outcomes		- Understand the fundamentals of Relational Model - Design Real Time applications using Database Query Language (SQL) - Familiarize with the different kinds of PL/SQL Objects - Understand the various Database applications using the Relational Model, ER model and EER model - Construct and normalize conceptual Data Models		
Theory Component				
Unit-No		Content	Hours	
Unit-I		Introduction to Relational model Structure of relational database, Database schema, Keys, Schema diagram, Relational Query language, Relational Algebra.	9	
Unit-II		Introduction to SQL SQL data definition, basic structure of SQL Queries, set operations, null values, aggregate functions, nested subqueries	9	
Unit-III		Intermediate and advanced SQL Join expressions, views, transaction, integrity constraints, functions and procedures, triggers.	9	
Unit-IV		Database design using ER model The Entity-Relationship model, complex attributes, mapping cardinalities, primary key, removing redundant attributes in entity sets, reducing ER diagrams to relational schemas, extended ER features.	9	
Unit-V		Relational database design Decomposition using functional dependencies, normal forms, First Normal Form, Second Normal Form, Third Normal Form, BCNF, Fourth Normal Form, Fifth Normal Form, functional dependency theory, algorithms for decomposition using functional dependencies, decomposition using multivalued dependencies.	9	
Recommended Learning Resources				

Text Books	1. Abraham Silberschatz, Henry F. Korth and S.Sundarshan, “Database System Concepts“, Seventh Edition, McGraw Hill International Edition, 2021. 2. Brumm.B, “Beginning Oracle SQL for Oracle Database 18c: From Novice to Professional”, First Edition, Apress, 2019.	
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Practical Component		
Title of the Practical: Database Management Systems		
Ex.No	Exercises	Hours
1	To implement the DDL commands using SQL	30
2	To implement the DML commands.	
3	To implement the DDL constraints, DCL, and TCL commands	
4	To implement various built functions and aggregate functions.	
5	To implement the various join operations.	
6	To implement the various nested subqueries.	
7	Creation and manipulation of Views.	
8	To practice the basics of PL/SQL [control structures].	
9	To create the functions and procedures using PL/SQL.	
10	To create the Triggers using PL/SQL.	
Tools/Software to be used	Oracle Database, MySQL	

Year	II	Course code:	Credits	4
Semester	IV	Course Title: Operating Systems	Hours	75
			Category	C
Course Prerequisites		Knowledge of computers & computer organization		
Course Outcomes		- To understand the basic concepts of Operating System and Process - To learn the various mechanisms of CPU scheduling, process synchronization and deadlocks - To understand how the memory is utilized - To analyze various File System methods and Disk scheduling algorithms - Evaluate system structures in various operating systems, such as Linux and Windows and identifying similarities and differences		
Theory Component				
Unit-No		Content	Hours	
Unit-I		Overview and Process management Introduction: Operating System Structures – Operating systems services – System calls. Process Management: Process Concept – process scheduling – operation on processes –CPU Scheduling: Basic Concepts – Scheduling Algorithms Inter process communications – Threads	9	
Unit-II		Process Synchronization and Deadlock Inter process communications – Threads - Process Synchronization: Critical Section problem – Semaphores – Classical problems of synchronization : Dining Philosopher, Producer and Consumer problem – Deadlock: Deadlock Characterization – Deadlock Handling – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection – Deadlock Recovery	9	
Unit-III		Memory Management Main Memory: Contiguous Memory Allocation – Relocatable Partitioned Allocation-Paging – Structure of the Page Table – Swapping Virtual Memory: Demand Paging – Page Replacement – Thrashing	9	
Unit-IV		Storage Management Mass Storage structure: Overview – HDD (Disk) Scheduling – storage management – RAID Structure File Systems: File concepts – Access methods – Directory Structure – File Protection – File system Implementation – File System Structure – File System Operations – Allocation methods	9	
Unit-V		Case Studies The Linux system: Design principles – kernel modules – process management – Scheduling – Memory Management – Linux File	9	

	System Windows Operating system: Systems components – Windows File System	
Recommended Learning Resources		
Text Books	1. Abraham Silberschatz Peter B Galvin, G. Gagne, “Operating Systems Concepts”, Tenth Edition, Addison Wesley, 2018. 2. William Stallings, “Operating Systems: Internals and Design Principles”, Tenth Edition, Prentice Hall, 2021.	

Practical Component		
Title of the Practical: Operating System		
Ex. No	Exercises	Hours
1	Practice File handling utilities, Process utilities, Disk utilities, and Networking commands	30
2	Write a program to implement various system call operations	
3	Write a program to demonstrate various File management operations	
4	Write a program to simulate CPU scheduling algorithms: FCFS, SJF, Round Robin, and priority	
5	Write a program to simulate solutions to Classical Process Synchronization Problems: Dining Philosophers, Producer – Consumer	
6	Write a program to simulate Bankers Algorithm for Deadlock Avoidance	
7	Write a program to simulate Page Replacement Algorithms: FIFO, Optima	
8	Write a programs to simulate implementation of disk Scheduling Algorithms	
Tools/Software to be used	1. C / Python 2. Linux OS	

Year	II	CourseCode:	Credits	4
Sem.	IV		CourseTitle:MathematicalFoundationsof Computer Science	Hours
			Category	A
Course Prerequisites,if any	Knowledgeoffunctions,algebra,andpre-calculus			
CourseOutcomes	- Understandlogicalstatementstructures - Applyoperationsinproblem-solving - Analyzeintegerrepresentationsandcongruences - Understandcountingprinciples - Evaluatecombinatorialsolutions			
UnitNo.	CourseContent			Hours
TheoryComponent				
UnitI	LogicandProofs Propositional Logic – Predicates and Quantifiers – Rules of Inference - Proofs – Methods and Strategy			15
UnitII	BasicStructures Sets–Functions–SequencesandSummations–Matrices Relations – properties – representation			15
UnitIII	NumberTheory Divisibility and Modular Arithmetic – Integer Representations and Algorithms – Primes and Greatest Common Divisors – Congruences			15
UnitIV	InductionandRecursion MathematicalInduction-StrongInductionandWellOrdering -RecursiveDefinitionsandStructuralInduction			15
UnitV	Counting Basics – Pigeonhole principle – Permutations and Combinations – Binomial Coefficients			15
PracticalComponent				
	-			-
RecommendedLearningResources				
PrintResources	- KennethH.Rosen,“DiscreteMathematicsanditsApplications”, Seventh Edition, McGraw Hill, Seventh Edition, 2017. - Trembley.J.PandManohar.R.,“DiscreteMathematicalStructures with Applications to Computer Science”, Tata McGraw Hill,, 2020.			

Year	II	Course Code: CourseTitle:DataMining	Credits	4
Sem.	IV		Hours	75
			Category	C
Course Prerequisites, ifany	DatabaseManagementSystems			
Course Outcomes	Studentswill beableto - Gainacomprehensiveunderstandingofdataminingconcepts - Acquireknowledgeindatapreprocessingtechniques - Gainknowledgeinpatternmining - Attainknowledgeandskillsin classification - Understandvariousclusteringalgorithms			
UnitNo.	CourseContent		Hours	
TheoryComponent				
UnitI	Introduction OverviewandHistory-DataMining-Typesofdata-Kinds of Patterns-Technologies Used - Applications - Major Issues inDataMining – DataObjectsandAttributeTypes – Basic Statistical Descriptions of Data		9	
UnitII	DataPreprocessing&DataWarehouse Data Preprocessing Overview - Data Cleaning - Data Integration-DataReduction-DataTransformation-Data Warehouse: BasicConcepts - DataCubeand OLAP -Data Generalization by Attribute-Oriented Induction		9	
UnitIII	PatternMining Pattern Mining Concepts - Market Basket Analysis - Frequent Itemsets - Closed Itemsets and Association Rules- FrequentItemsetMiningMethods-Pattern EvaluationMethods		9	
UnitIV	Classification Fundamentals - Decision Tree Induction - Bayes Classification-RuleBasedClassification-ModelEvaluation and selection - Techniques to Improve Classification Accuracy		9	
UnitV	Clustering Cluster Analysis - Partitioning methods - Hierarchical methods-Agglomerative,Divisivehierarchicalclustering- DBSCAN – Evaluation		9	
PracticalComponent				
Exercises	1. Performpreprocessingforthegivendataset 2. ProgramtoIntegratetwodatasetswithcommon attributes 3. Program to transform categorical data into numerical format for analysis 4. Programtocreateabasicdatacubeandperform OLAP operations 5. ImplementtheApriorialgorithmforminingfrequent itemsets 6. ImplementK-meansclusteringalgorithm 7. ImplementK-Medoidsalgorithm 8. ImplementDBSCANalgorithm		30	

Recommended Learning Resources		
Print Resources	1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining Concepts and Techniques, Morgan Kaufman, 4th Edition, 2022 2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson India Education Services Pvt. Ltd, 2016.	

Semester-V

Year	III	Course code:	Credits	4
Semester	V	Course Title: ComputerSystemArchitecture	Hours	75
			Category	C
Course Prerequisites	BasicknowledgeofComputerandDigitalLogic			
Course Outcomes	• Understand the basic functions of computer • Workingwithbinaryandarithmeticoperations • UnderstandtheorganizationofCPUandworkingprinciples • UnderstandtheInput-Outputorganizationinacomputer • UnderstandtheMemoryorganizationinacomputer			
Theory Component				
Unit-No	Content			Hours
Unit-I	Introduction to Computer Systems Evolution of computers and computer generations - Basic functional units of a computer - Computer organization vs. computer architecture - Instruction execution cycle - Types of computer systems (desktop, server, embedded systems) - Performance metrics: clock rate, CPI, MIPS, MFLOPS			9
Unit-II	DataRepresentationandTransfer Datatypes-Complements-Fixed-PointRepresentation-Floating Point Representation - Register Transfer - Bus and Memory Transfer - Arithmetic - Logic and Shift Micro operations			9
Unit-III	CPU Organization RegisterandStack-InstructionFormat-AddressingModes-Data TransferandManipulation-ProgramControl-RISC-BasicsofPipelining			9
Unit-IV	Input-OutputOrganization Peripheral devices - I/O Interface - Asynchronous data transfer - Modesoftransfer-PriorityInterrupt-DMA-Serial Communication			9
Unit-V	MemoryOrganization MemoryHierarchy-MainMemory-AuxiliaryMemory-AssociativeMemory-CacheMemory-VirtualMemory–Memory ManagementHardware			9
RecommendedLearningResources				
Text Books	1. MorrisMano,“ComputerSystemArchitecture”,PearsonEducation, 2017. 2. Computer Organization and Architecture — William Stallings.			
Reference Books	1.Structured Computer Organization — A.S. Tanenbaum 2.Computer Organization — Carl Hamacher et al.			

Practical Component		
Title of the Practical: Computer system Architecture		
Ex. No	Exercises	Hours
1.	Simplify Boolean expressions using Karnaugh maps.	30
2.	Design a combinational circuit	
3.	Implementing Logical Left and Right Shifts	
4.	Understand different data types and how to calculate complements	
5.	Evaluate performance improvement through instruction level parallelism	
6.	Analyze the effect of cache performance on system performance.	
7.	Understand the impact of memory hierarchy on access time.	
Tools/Software to be used		Logisim - win – 2.7.1 / Simulator New

Year	III	Course code:	Credits	4
Semester	V	Course Title: Computer Networks	Hours	75
			Category	C
Course Prerequisites	Fundamentals of computers			
Course Outcomes	• Learn the basics of Network topology • Learn about the various physical network media • Understand the functionalities of all the network layers • Familiarize the protocols of different layers • Implement the various network protocols			
Theory Component				
Unit-No	Content			Hours
Unit-I	Introduction and Physical Layer Introduction to Networks, Topology, Network Architecture, Reference Models, Transmission Media: Guided Media & Unguided Media, Multiplexing & De-Multiplexing, Switching.			9
Unit-II	Data link layer Data link layer Design Issues, Error Detection and Correction , Elementary Data Link Protocols, Sliding window Protocols			9
Unit-III	Network Layer Design Issues, Routing , Logical Addressing, IP Working- IPV4 Vs IPV6, Address Mapping, delivery, Forwarding, Routing Algorithm: Distance Vector – Link State – Flooding-Broadcast-Multicast.			9
Unit-IV	Transport Layer The Transport Service, Service provided to the Upper Layers, Flow Control & Buffering, TCP Congestion Control, UDP , TCP Vs UDP			9
Unit-V	Upper Layers Session Layer functions: Dialogue control and Synchronization Presentation Layer functions: Data Compression, Encryption & Decryption, and Translation. Application Layer functions: Domain Naming System, DNS Namespace, Resource Records, Name Servers, Electronic mail, Messages Formats, Message Transfer.			9
Recommended Learning Resources				
Text Books	1. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, Fifth Edition, Prentice Hall publisher, 2022. 2.Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2015.			
Reference Books	1.James F. Kurose, Keith W. Ross,” Computer Networking - A Top-Down Approach Featuring the Internet”, Seventh Edition, Pearson Education, 2022.			

Practical Component		
Title of the Practical: Computer Networks		
Ex. No	Exercises	Hours
1	Implementation of Basic Chat	30
2	Implementation of File Transmission	
3	Implementation of Client Server Application using RMI	
4	Implementation of Client Server Application Using Socket	
5	Implementation of Error Detection Techniques	
6	Implementation of Error Correction Techniques	
7	Implementation Sliding Window Protocol	
8	Implementation of Routing Algorithms.	
9	Implementation of congestion control strategy	
10	Implementation of RSA Algorithm	
Tools/Software to be used		Java JDK/Python

Year	III	Course code:	Credits	4
Semester	V	Course Title: Design and Analysis of Algorithms	Hours	3
			Category	45
Course Prerequisites		Basic Knowledge in Data Structures and Programming		
Course Outcomes		- Analyze the efficiency of algorithms and compare their performance using appropriate metrics - Understand the general approach of Brute Force and Divide and Conquer algorithms - Understand the principles of the Greedy Method in algorithm design - Understand the principles of Dynamic Programming - Understand the principles of Backtracking and branch and bound strategies		
Theory Component				
Unit-No	Content		Hours	
Unit-I	Introduction Notation of Algorithm – Analysis of Algorithm Efficiency – Asymptotic Notations and Basic Efficiency classes – Mathematical Analysis of Non recursive and recursive Algorithms		9	
Unit-II	Divide and Conquer Brute Force and Divide and conquer – Binary Search – Finding the maximum and minimum – merge sort – quick sort		9	
Unit-III	Greedy Method General method – Knapsack problem – Job Sequencing – Spanning Trees – Prims’s Algorithm and Kruskal’s Algorithm		9	
Unit-IV	Dynamic Programming General method – Principle of Optimality – Multistage Graphs – 0/1 Knapsack – Travelling Salesman Problem		9	
Unit-V	Backtracking & Branch Bound Backtracking – General Method – 8-Queen Problem – Sum of Subsets – Hamiltonian Cycles – Branch and Bound: Introduction FIFO Solution – LC Branch and Bound – 0/1 Knapsack		9	
Recommended Learning Resources				
Text Books:	1. Horowitz E. and Sahani S., “Fundamentals of Computer Algorithms”, Second Edition, Universities press, 2008. 2. S. Sridar, “Design and Analysis of Algorithms”, Oxford University Press, 2014			

Practical Component		
Title of the Practical: Design and Analysis of Algorithm		
Ex. No	Exercises	Hours
1	Write recursive and iterative algorithms and analyze the time complexities of using Big-O notation	30
2	Implement and compare the efficiency of sorting algorithms (e.g., bubble sort, quicksort) on different input sizes	
3	Implement merge sort and analyze its time complexity with different input sizes	
4	Implement binary search algorithm	
5	Implement a greedy algorithm for the knapsack problem and analyze its efficiency	
6	Implement Prim's algorithm for finding the minimum cost spanning tree	
7	Implement Kruskal's algorithm for the same purpose and compare the results	
8	Solve the 0/1 knapsack problem using dynamic programming and analyze the time complexity	
9	Implement a backtracking solution for the subset sum problem and analyze its efficiency	
10	Implement backtracking solution for 8-Queens problem	
Tools/Software to be used	Python	

Year	III	CourseCode:CSIT309		Credits	4
Sem.	V	CourseTitle:OperationsResearch		Hours	75
				Category	A
Course Prerequisites,if any	BasicMathematicalandProblemSolvingSkills				
Internal Assessment Marks:25	EndSemesterMarks:75		DurationofESA(Theory):03hrs.		
Course Outcomes	- UnderstandandcomprehendthebasicsofLinearProgramingProblem (LPP) - LearnLPPsolvingmethodsandexploredualityinLPP - Solveassignmentproblemandtheirvariants - Findthefeasibleandoptimalsolutionsfortransportationproblems - Performcriticalpathanalysisandreviewingofaproject				
UnitNo.	CourseContent			Hours	
TheoryComponent					
UnitI	Introduction OperationResearch–Definition–Characteristics–Techniques – Applications. LPP – Introduction – Applications and components of LPP – Steps in solving LPP.			15	
UnitII	LPP Mathematical formulation – Graphical method – Simplex method – Artificial variables – Big-M method - Two-phase method – Degeneracy and unbound solutions – Duality in LPP – Formulation – Relationship between primal and dual problems.			15	
UnitIII	AssignmentModel Mathematicalformulations-HungarianMethod–Variantsof theAssignment problem.			15	
UnitIV	TransportationProblem Mathematical formulation – Finding basic feasible solutions – NWCR, LCM and VAM – Optimal solution – MODI method.			15	
UnitV	NetworkScheduling Introduction – Basic components – Logical sequencing – Rules of network construction –Concurrent Activities – Critical Path Analysis -Activity Time and Floats – Project Evaluation and ReviewTechnique(PERT)–ThreeTimeEstimates–CriticalPath Analysis of PERT network – Probability of completion of Project.			15	
PracticalComponent					
	-				
RecommendedLearningResources					
PrintResources	- KantiSwarup,P.K.Gupta,ManMohan,“OperationsResearch”, 20th Edition, Sultan Chand & Sons, 2023. - TahaH.A.,“OperationsResearch:AnIntroduction”,10thEdition, Pearson Education, 2019.				

Year	III	CourseCode: CourseTitle:BigDataAnalytics	Credits	4
Sem.	V		Hours	75
			Category	C
Course Prerequisites, if any	Basicunderstandingofprogramming			
Course Outcomes	- UnderstandtheRoleofBigDataTechnologies. - GainaworkingknowledgeofBigDataEcosystems - ImplementandunderstandthebasicsofHadoopandMapReduce - DevelopfoundationalskillsforfurtherexploringBigDatatechnologiesandtools			
UnitNo.	CourseContent		Hours	
TheoryComponent				
UnitI	IntroductiontoBigData IntroductiontoBigData:TypesofDigitalData-CharacteristicsofData – Evolution of Big Data – Definition of Big Data – Challenges with Big Data–3VsofBigData –NonDefinitionaltraitsofBigData –Business Intelligencevs.BigData–DataWarehouseandHadoopenvironment – Coexistence.		9	
UnitII	IntroductiontoBigDataAnalyticsandNoSQL Big Data Analytics: Classification of analytics – Data Science Terminologies in Big Data – CAP Theorem – BASE Concept. IntroductiontoNoSQL:TypesofDatabases–Advantages–NewSQL–SQLvs.NoSQLvsNewSQL.		9	
UnitIII	IntroductiontoHadoopEcosystems IntroductiontoHadoop:Features–Advantages–Versions–Overview of Hadoop Ecosystems – Hadoop distributions – Hadoop vs. SQL – RDBMS vs. Hadoop – Hadoop Components – Architecture – HDFS – MapReduce:Mapper–Reducer–Combiner–Partitioner–Searching –Sorting– Compression.		9	
UnitIV	IntroductiontoNoSQLDatabase NoSQLdatabases:MongoDB:Introduction–Features–Datatypes– Mongo DB Query language – CRUD operations – Arrays – Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce. Cursors – Indexes – Mongo Import – Mongo Export.		9	
UnitV	IntroductiontoHiveandPigArchitectures IntroductiontoHive–Architecture –datatype– Fileformat– HQL– SerDe–User-definedfunctions.		9	
PracticalComponent				
Exercises	- InstallBigDatatools(Hadoop,MongoDB,Hive,andPig) - ExploreHadoopCommands - ExploreMongoDBDatasets - ImplementasimpleHadoopprogramforwordcount - ImplementasimpleMapReduceprogramforfindingthe average length of words starting with each character. - BasicMongoDBdatabasecreation. - ImplementbasicMongoDBdatabasemanipulation commands.		30	

Recommended Learning Resources	
Print Resources	1. Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley Publication, 2nd Edition, 2019. 2. Tom White, Hadoop: The Definitive Guide, O'Reilly Publications, 2011. 3. Kyle Banker, MongoDB in Action, Manning Publications Company, 2012. 4. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, Big Data for Dummies, John Wiley & Sons, Inc., 2013.

Year	III	Course code:	Credits	3
Semester	VI	Course Title: SoftwareEngineeringTheoryand Practice	Hours	75
			Category	C
Course Prerequisites	Basic knowledge of programming and information systems			
Course Outcomes	- Understand the fundamental concepts of design thinking - Analyze and document the software requirements - Apply appropriate software engineering design concepts to develop software. - Apply software testing strategies - Understand and consider the significance of security in software development process			
Theory Component				
Unit-No	Content			Hours
Unit-I	Introduction to Design Thinking Design process – Traditional design - Design thinking – Existing sample design projects - Study on designs around us- Compositions/structure of a design -Innovative design - Breaking of patterns - Reframe existing design problems – Principles of creativity Empathy - Customer Needs – Insight – leaving from the lives of others/standing on the shoes of others - Observation.			9
Unit-II	Software Engineering and Software Requirements Defining software engineering, Software lifecycle models ,Selection of a life cycle model - Requirements engineering, Types of requirements, Feasibility studies, Requirements elicitation, Requirement analysis, Requirement documentation, Requirement validation.			9
Unit-III	Software Project Planning Size estimation, Cost estimation, Models ,Constructive cost model, Software risk management, Software design, Modularity, Strategy of design, Function oriented design, Object oriented design.			9
Unit-IV	Testing Strategies A strategic approach to software testing, Test strategies for conventional software, Black – Box and White – Box testing, Validation testing, System testing, The art of Debugging.			9
Unit-V	Secure Software Engineering Introduction - The problem - Software assurance and software security-Threats to software security – Software in security - Benefits of detecting software security defects early - Managing			9

	secure software development –Defining Properties – Influencing the security properties of software –To assert and specify desired security Properties.	
Recommended Learning Resources		
Text Books	1. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", 1"edition, HarperCollins Publishers Ltd, 2019. 2. Roger S. Pressman, Bruce Maxim, "Software Engineering, A Practitioner's Approach", 9"edition, McGraw Hill International Edition, 2023.	
Reference Books	1. .Allen, "Software Security Engineering: A Guide for Project Managers", 1"edition, 2008.	

Practical Component		
Title of the Practical: SoftwareEngineeringTheoryand Practice		
Ex. No	Exercises	Hours
1.	Study of Software Engineering & Life Cycle Models	30
2.	Library System	
3.	Course Registration System	
4.	Quiz System	
5.	Student marks analyzing system	
6.	Online ticket reservation system	
7.	Stock maintenance System	
8.	Test Strategy Development	
9.	Requirement Validation	
10.	Software Project Planning	
Tools/Software to be used	Star UML	

Year	III	Course code:	Credits	4
Semester	VI	Course Title: Web Engineering	Hours	75
			Category	C
Course Prerequisites	- Understand the process of web publishing - Acquire skills developing web pages using HTML - Acquire skills to style the web pages using CSS			
Course Outcomes	- Acquire skills to build server-side web components - Explore the mobile web development process			
Theory Component				
Unit-No	Content			Hours
Unit-I	Introduction to World Wide Web Introduction to web publishing – Web browsers – Web servers – Uniform Resource Locators – Using browser-based developer tools.			9
Unit-II	Introduction to HTML and CSS Structuring a web page with HTML – Basic elements – Lists – Links – Tables – Images – Forms Using CSS to style a site – CSS for positioning – Integrating Multimedia elements			9
Unit-III	Introduction to JavaScript The structure – Operators – Variables – Control structures – Functions – Arrays – Objects – Validation			9
Unit-IV	Introduction to PHP Setting up the server – PHP language basics – built-in functions – library functions – using includes – database connectivity – sending email – cookies and sessions – File uploads			9
Unit-V	Mobile Web Mobile browsing needs – text on mobile web – design and page layout – links – images and multimedia – CSS for mobile – making use mobile features – Best practices			9
Recommended Learning Resources				
Text Books	1. Laura Lemay, Rafe Coburn, Jennifer Kyrnin, “Sams Teach yourself HTML, CSS & Javascript Web Publishing, Pearson Education, 2016.			

Practical Component		
Title of the Practical: Web Engineering		
Ex. No	Exercises	Hours
1	Build your resume using simple static html	
2	Enrich your resume with CSS	
3	Implement an HTML Form with JavaScript validation	
4	Build a web application to demonstrate event handling in JavaScript	
5	Add a server-side component to the task #3	
6	Build a server-side data storage web application	
7	Build a web application to demonstrate session handling	
8	Build a web application to demonstrate cookies handling	
9	Implement mobile web application	
10	Implement file uploads in a web application	
Tools/Software to be used		HTML, Javascript, PHP

Year	III	Course code:	Credits	4
Semester	VI	Course Title: Soft Computing	Hours	75
			Category	C
Course Prerequisites		Basic knowledge of mathematics, programming concepts, algorithms, familiarity with problem-solving and logical reasoning.		
Course Outcomes		• Understanding of different soft computing techniques • Ability to identify, analyze and apply suitable soft computing techniques to solve real life problems • Apply genetic algorithms for real-time search, optimization, and design problems • Apply neural networks for pattern recognition and prediction tasks • Apply fuzzy reasoning for real-time control systems		
Theory Component				
Unit-No		Content	Hours	
Unit-I		Introduction to Soft Computing: Introduction, Soft Computing vs Hard computing, Soft computing characteristics, Constituents of soft computing, From conventional AI to Computational Intelligence	9	
Unit-II		Fuzzy Set Theory, Fuzzy Logic and Fuzzy Reasoning: Introduction, Fuzzy Set and Fuzzy Logic, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Decision Making, Fuzzy Clustering, Fuzzy Expert System.	9	
Unit-III		Genetic Algorithms: Introduction to Optimization, Basic Concepts of Genetic Algorithms (GA), Working principle, Encoding, Fitness function, Genetic Operators - Selection, Crossover, Mutation, Convergence of GA, Variants of GA, Multi-objective Optimizations with GA, Applications of GA	9	
Unit-IV		Neural Network: Introduction to machine learning with Neural Networks, Types of learning, Neural network architectures, Single layer networks, Multilayer networks with backpropagation learning, Radial basis function Networks, Unsupervised learning with Neural Networks, Advances in Neural Networks, Applications of neural networks, Overview of Reinforcement Learning	9	

Unit-V	Hybrid systems: Types of Hybridizations, Neuro-fuzzy systems, Neuro-genetic Systems, Fuzzy genetic systems, Applications of hybrid systems	9
Recommended Learning Resources		
Text Books	3. JyhShing Roger Jang, Chuen Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice Hall of India, 2003 4. S.N.Sivanandam, S.N.Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd	

Practical Component		
Title of the Practical:		
Ex.No	Exercises	Hours
1	Implementation of Single layer networks	30
2	Implementation of Multilayer networks with Backpropagation algorithms	
3	Use of neural networks for classification applications-1	
4	Use of neural networks for classification applications-2	
5	Use of neural networks for regression applications	
6	Working with genetic algorithms	
7	Using GA for various optimization problems	
8	Design of Fuzzy control systems	
9	Application development using Fuzzy control systems	
10	Implementation of fuzzy C-means clustering	
11	Study of hybrid systems	
Tools/Software to be used		

Year: III	Course code:		Credits	4
Semester: VI	Course Title:	IT Infrastructure Management	Hours	45
			Category	C
Course Prerequisites	Knowledge of IT infrastructure			
Course Outcomes	- Understand the fundamentals of IT infrastructure concepts - Familiarize with the current computing environment - Acquire skills in managing Information Systems - Gain knowledge of the ITIL library for IT infrastructure Management - Develop the ability to compute information system costs and create budgets for information systems			
Theory Component				
Unit-No	Content		Hours	
Unit-I	IT Infrastructure: Overview Definitions, Infrastructure management activities, Evolutions of Systems since 1960s (Mainframes-to-Midrange-to-PCs-to-Client-server computing-to-New age systems) and their Management, growth of internet, current business demands and IT systems issues, complexity of today's computing environment, Total cost of complexity issues, Value of Systems management for business		9	
Unit-II	IT Infrastructure Management Factors to consider in designing IT organizations and IT infrastructure, Determining customer's Requirements, Identifying System Components to manage, Exist Processes, Data, applications, Tools and their integration, Patterns for IT systems management, Introduction to the design process for information systems, Models, Information Technology Infrastructure Library (ITIL).		9	
Unit-III	Current computing environment Complexity of current computing, multiple technologies, multiple vendors, multiple users, e- Waste disposal, Total cost of ownership.		9	
Unit-IV	IT system Management Common tasks in IT system management, approaches for organization Management, Models in IT system design, IT management systems context diagram, patterns for IT system Management.		9	
Unit-V	Establishing business value of information system Information system costs and benefits, Capital budgeting for information system, Real Options pricing models, Limitation of		9	

	financial models.	
Recommended Learning Resources		
Print Resources	Text Books: 1. Gupta, "IT Infrastructure & Its Management", Tata McGraw-Hill Education, 2010. 2. Choubey, Manoj Kumar, "IT Infrastructure and Management: For the GBTU and MMTU", Pearson Education India, 2011.	
	Reference: 1. Anita Sengar, "IT Infrastructure Management", S.K. Kataria & Sons 2. Ashish Avasthi, "Information Technology and Infrastructure Management", Himalaya Publishing House	

Practical Component		
Title of the Practical: IT Infrastructure Management		
Ex.No	Exercises	Hours
1.	Performing capital budget for Information Systems	30
2.	Perform a study of recent Gartner's report on IT infrastructure and prepare report on the same.	
3.	Perform a study of white paper on recent trends in IT Infrastructure and prepare a report on the same.	
4.	Perform a study of IT Infrastructure Management consulting companies in India and Abroad and prepare a report on the same	
5.	Perform a study of ITIL and prepare a report on the same	
6.	Perform a study of Five ITIL tools and prepare a report on the same	
7.	Perform a study of e-Waste disposal process/policy for Five IT industries and prepare a report on the same	
8.	Perform a study of IT infrastructure Management tools and prepare a report on the same	
9.	Perform a study of IT infrastructure Management Models and prepare a report on the same	
10.	Perform a study of white papers and case studies on Real Option Valuation and prepare a report on the same	
Tools/Software to be used		--

Year	IV	CourseCode:	Credits	4
Semester	VII	CourseTitle:DistributedSystems	Hours	75
			Category	C
Course Prerequisites, if any	BasicknowledgeofOperatingSystemsand ComputerNetworks			
Course Outcomes	• LearnbasicconceptsofDistributedSystems • Understandstate-of-the-artdistributedsystem • DesignanddevelopClient/ServerApplications • Learntosetupfaulttoleranceandreplicationservers • DesignandimplementCORBAandDCOM			
Unit No.	CourseContent			Hours
TheoryComponent				
UnitI	Introduction Definition – Goals – Hardware and Software Concepts – Client / Server Model Communication – Layered Protocols RPC – Remote Object Invocation – Message Oriented Communication			9
UnitII	Client Server ClientServerandNamingEntity–Threads–ClientServer–Code Migration – S/W Agents – Naming Entity – Location Mobile Entity			9
UnitIII	Synchronization Distributed Transactions – Synchronization – Clock Synchronization– Logical Clocks – Global States – Election Algorithms – Mutual Exclusion– DistributedTransactionConsistencyandReplication– DataCentricConsistency –FaultTolerance –DistributedCommit– Recovery			9
UnitIV	DistributedObjects DistributedObjectDatabaseSystem–CORBA– DCOM–GLOBE			9
UnitV	DistributedFileSystem Introduction-DistributedFileSystem –DistributedDocumentbased System – WWW – Distributed Coordination based System – JINI			9
RecommendedLearningResources				

Text Books	1. Andrew S. Tanenbaum, Maarten van Steer, "Distributed Systems Principles and Paradigms", Third Edition, Prentice Hall India, 2017. 2. George Coulouris, Jean Dollimore and Tim Kinderberg, "Distributed Systems - Concepts and Design", Fifth Edition, Addison-Wesley, 2011.
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Practical Component		
Title of the Practical: Distributed Systems		
Ex. No	Exercises	Hours
1	Perform arithmetic operation using RMI	30
2	Calculate simple and compound interest using RMI	
3	Implementation of ATM using RMI	
4	Implementation of Telephone Directory using RMI	
5	Implementation of Quiz Server using Servlets.	
6	Implementation of Online Shopping System using servlets	
7	Implementation of Matrimonial System using servlets	
8	Implementation of servlet-based Airline Reservation System	
9	Create a Word Document with text using DCOM and Visual Basic.	
Tools/Software to be used		Java/Python

Year	IV	CourseCode:	Credits	4
Semester	VII	CourseTitle: SystemModellingandSimulation	Hours	75
			Category	C
Course Prerequisites, ifany	BasicknowledgeinStatistics			
Course Outcomes	• Understandthefundamentalsofmodellingandsimulation • Learnaboutstatisticalmodelsandinputmodelling • Understandthetechniquesforrandomnumbergeneration • Performthesimulation of dynamicsystems • Ableto verifythesimulationmodels			
Unit No.	CourseContent		Hours	
TheoryComponent				
UnitI	Introduction Simulation tool - Advantages and disadvantages ofSimulation - Areas of application- Systems and system environment - Components of a system; Discrete and continuous systems - Model of a system; Types of Models - Discrete-Event System Simulationexample-Simulationofqueuing systems-General Principles.		9	
UnitII	StatisticalModels in Simulation Reviewofterminologyandconcepts-Usefulstatisticalmodels- Discrete distributions - Continuous distributions - Poisson process - Empirical distributions - General Principles - Characteristics of queuing systems - Queuing notation - Long-runmeasuresofperformanceofqueuing systems-Steady-state behaviourofM/G/1queue-Networksofqueues.		9	
UnitIII	Random-NumberGeneration Propertiesofrandomnumbers -Generation ofpseudo-random numbers - Techniques for generating random numbers - Tests forRandomNumbers-InversetransformtechniqueAcceptance -Rejectiontechnique.		9	
UnitIV	InputModeling Data Collection - Identifying the distribution with data - Parameter estimation - Goodness of Fit Tests - Fitting a non-stationaryPoisson process-Selectinginputmodels withoutdata – Multivariate & Time - Series input models -Types of simulationswithrespecttooutputanalysis-Stochasticnature ofoutputdata-Measuresofperformance andtheirestimation		9	

Unit V	Simulation Models Measures of performance and their estimation - Output analysis for terminating simulations - Output analysis for steady - state simulations - Verification, Calibration and Validation - Optimization, Model building, verification and validation - Verification of simulation models - Verification of simulation models - Calibration and validation of models, Optimization via Simulation.	9
Recommended Learning Resources		
Text Books	1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, "Discrete-Event System Simulation", Fifth Edition, Pearson Education, 2013. 2. Lawrence M. Leemis, Stephen K. Park, "Discrete-Event Simulation: A First Course", Pearson Education, 2013.	

Practical Component		
Title of the Practical: System Modelling and Simulation		
Ex. No	Exercises	Hours
1	Computer Generation of Random Numbers.	30
2	Chi-square goodness-of-fit test	
3	One-sample Kolmogorov-Smirnov test	
4	Test for Standard Normal Distribution	
5	Monte-Carlo Simulation.	
6	Simulation of Single Server Queuing System.	
7	Simulation of Two-Server Queuing System.	
8	Simulate and control a conveyor belt system	
9	Two-sample Kolmogorov-Smirnov test	
Tools/Software to be used		

Year	IV	CourseCode:	Credits	4
Semester	VII	CourseTitle:WirelessCommunicationNetworks	Hours	75
			Category	C
Course Prerequisites, if any		Knowledgein Computer Networks		
Course Outcomes		- Understand basics of Wireless Communication Networks - Understand the Satellite Communication Concepts and compare generations of wireless communications. - Explore IEEE 802.11 WLAN standard - Explore WAP and its application - Understand WLAN Technologies		
Unit No.	CourseContent		Hours	
TheoryComponent				
Unit-I	Introduction Wireless Communication Technology- Antennas and Propagation - Antennas, Propagation Modes, Line-of-Sight Transmission, Fading in the Mobile Environment. Signal Encoding Techniques- Signal Encoding Criteria, Digital Data- Analog Signals, Analog Data- Analog Signals, Analog Data-Digital Signals.		9	
Unit-II	Satellite Communications Wireless Networking - Satellite Communications- Satellite Parameters and Configurations, Capacity Allocation-Frequency Division, Capacity Allocation-Time Division Cellular Wireless Networks- Principles of Cellular Networks, First-Generation Analog, Second-Generation - TDMA, CDMA, 3G Systems		9	
Unit-III	Wireless LAN Standards Evolution of IEEE 802.11 – Introduction to IEEE 802.11 – General Description – Medium Access Control (MAC) for the IEEE 802.11 – WLANs Physical Layer for IEEE 802.11 – WLANs; Radio systems – IR Systems Applications.		9	
Unit-IV	Mobile IP : Introduction, operation of Mobile IP, Mobile IP terminologies, Wireless Access Protocols: Introduction, Architecture overview, Wireless application environment		9	
Unit-V	Wireless LAN technology: Wireless LAN- application, requirements, Technology: Infrared, spread spectrum, Narrowband microwave (radio), Introduction Bluetooth Technologies (Only Overview).		9	

Recommended Learning Resources		
Text Books	1. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, Fifth Edition, Prentice Hall publisher, 2022. 2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2015.	
Reference Books	3. James F. Kurose, Keith W. Ross,” Computer Networking - A Top-Down Approach Featuring the Internet”, Seventh Edition, Pearson Education, 2022.	

Practical Component		
Title of the Practical: Wireless Communication Networks		
Ex. No	Exercises	Hours
1	Study about different Wireless devices like Wi-Fi Dongler, Wireless Access Point, Antenna, Wi-Fi Router.	30
2	Configure a wireless LAN using CISCO Packet Tracer	
3	Develop a client server application using Wireless LAN	
4	Simulate Blue Tooth Communication after pairing in CISCO packet Tracer.	
Tools/Software to be used		

Year: IV	Course code:		Credits	4
Semester: VII	Course Title:	Cloud Computing	Hours	45
			Category	C
Course Prerequisites	Knowledge of Distributed Systems and Databases			
Course Outcomes	• Understand cloud computing evolution and characteristics • Comprehend the architecture of cloud computing and differentiate between Infrastructure as a Service(IaaS) and Software as a Service (SaaS) • Recognize PaaS features and examples • Compare scaling hardware using SLAs and billing principles • Evaluate cloud security measures			
Theory Component				
Unit-No	Content			Hours
Unit-I	Introduction Overview of Computing Paradigm - Recent trends in Computing – Grid Computing, Cluster Computing ,Distributed Computing, Utility Computing, Cloud Computing - Evolution of cloud computing - Cloud Computing (NIST Model) Characteristics - Pros and Cons of Cloud Computing ,Cloud computing vs. Cluster computing vs. Grid computing-Role of Open Standards			9
Unit-II	Infrastructure as a Service (IaaS) & Software as a Service SaaS Cloud Computing Architecture - Cloud computing stack - Service Models (XaaS) - Deployment Models. Infrastructure as a Service (IaaS)–Introduction-Virtualization, Hypervisors, Machine Image, Virtual Machine (VM)- Examples).			9
Unit-III	Platform as a Service(PaaS) Platform as a Service (PaaS) - Introduction - Cloud Platform and Management –Examples, Microsoft Azure, SalesForce.com - SoftwareasaService-Introduction-Webservices-Web2.0-Web OS - Case Study on SaaS.			9
Unit-IV	Service Management in Cloud Computing Service Management in Cloud Computing - Service Level Agreements (SLAs) - Billing & Accounting - Comparing Scaling Hardware: Traditional vs. Cloud-Economics of scaling, Scalability &Cloud Services.			9

Unit-V	Cloud Security Cloud Security-Infrastructure Security-Data security and Storage -Data privacy and security Issues, Jurisdictional issues-Identity& Access Management - Access Control - Trust, Reputation, Risk.	9
Recommended Learning Resources		
Print Resources	TextBook: RajkumarBuyya,JamesBroberg,AndrzejGoscinski, “Cloud Computing: Principles and Paradigms”, First Edition, Wiley, 2013. 2. RonaldL.Krutz,RussellDeanVines,“CloudSecurity:AComprehensive Guide to Secure Cloud Computing”, First Edition, Wiley, 2010.	
	Reference: 1. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi <i>Mastering Cloud Computing: Foundations and Applications Programming</i> 1st Edition, McGraw Hill Education, 2013. 2. Thomas Erl, Ricardo Puttini, Zaigham Mahmood <i>Cloud Computing: Concepts, Technology & Architecture</i> 1st Edition, Prentice Hall / Pearson Education, 2013.	

Practical Component		
Title of the Practical: Cloud Computing lab		
Ex. No	Exercises	Hours
1	Install Virtual box/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8	30
2	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs	
3	Install GoogleAppEngine.Create‘helloworld’appand other simple web applications using python/java	
4	Use GAE launcher to launch the web applications	
5	Simulate a cloud scenario using Cloud Simandruna scheduling algorithm that is not present in CloudSim	
6	Find a procedure to transfer the files from one virtual machine to another virtual machine	
7	Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version)	
8	Install Hadoop single node cluster and run simple applications like word count	

Tools/Software to be used	Case study
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	Course code:		Credits	4
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Year: IV				
Semester: VII	Course Title:	Cryptographyand Cybersecurity	Hours	45
			Category	C
Course Prerequisites	Knowledgeofcomputernetworksandprogramming			
Course Outcomes	- UnderstandthebasicsofInformationsecurityandthreats - Learnthevarioussecuritycryptosystems - Comprehendthevarioustypesofdataintegrityandauthenticationschemes - Analysethevariousnetworksecurityprotocols - UnderstandNetworkandOperatingSystemSecurity			
Theory Component				
Unit-No	Content		Hours	
Unit-I	IntroductiontoCryptographyandattacks Foundation of Computer and Information Security: Definition - Models for Discussing Security Issues - Attacks and its types – Threats, vulnerabilities and Risk - risk management – Incident response and Defense in depth.		9	
Unit-II	Cryptography TheHistoryofCryptography-ModernCryptographicTools-ProtectingDataat Rest, in Motion, and in Use – Symmetric Key algorithms and AES:Algorithmic types andmodes-DES-IDEA–AsymmetricKeyAlgorithms: Overview-RSA–Digital Signatures		9	
Unit-III	AuthorizationandAccessControls Definition - Implementing Access Controls - Access Control Models - Auditing andAccountability:AccountabilitySecurityBenefitofAccountability–Auditing		9	
Unit-IV	CryptographicProtocols SSL- TLS,SHTTP,TSP,SET,WAPSecurity,SecurityinGSM,3G.Authentication basics – Kerberos – Firewalls – IP security – VPN – Intrusion		9	
Unit-V	NetworkandOperatingSystemSecurity Human element Security – Physical threat Identification and control, Protecting- people, data and equipment – Designing secure network using firewall and IDS – Protecting Network traffic using network security tools - Mobile, Embedded, IoT Security.		9	
RecommendedLearningResources				

Print Resources	Text Books: 1. JasonAndress,“Foundations of Information Security-A Straightforward Introduction”, William Pollock Publisher, 2019. 2. AtulKahate,“Cryptography and Network Security”,McGrawHill Education,2019.
	Reference: 1. William Stallings – “<i>Cryptography and Network Security: Principles and Practice</i>”, Pearson publisher 2. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies –“<i>Security in Computing</i>”, Pearson publisher.

Practical Component		
Title of the Practical: Cryptography and Cybersecurity		
Ex.No	Exercises	Hours
1	Perform encryption, decryption using Caesar cipher substitution techniques	30
2	Perform encryption, decryption using Hill cipher substitution techniques	
3	Perform encryption, decryption using Hill cipher substitution techniques	
4	Perform encryption and decryption using following transposition techniques - Rail fence row & Column Transformation	
5	Apply the DES algorithm for practical applications	
6	Apply the AES algorithm for practical applications	
7	Implement the RSA Algorithm	
8	Implement the Diffie-Hellman Key Exchange algorithm for a given problem	
9	Calculate the message digest of a text using the SHA-1 algorithm	
10	Implement the SIGNATURE SCHEME – Digital Signature Standard Installing and Configuring Open source Firewalls and IDS	
Tools/Software to be used	JAVA/Python	

Year	IV	Course Code: CSIT406	Credits	4
Sem.	VII		Hours	75

		CourseTitle:BlockchainTechnologies	Category	C
Course Prerequisites, if any	Knowledgeofprogramming,cybersecurityandcryptography			
Course Outcomes	- Understandingthefundamentalsandimportanceofblockchaintechnology - Evaluatingandselectingtheappropriateblockchainplatform - DeployingblockchaintoolsandgettingstartedwithChainonAzure - Exploringtheroleofblockchaininsmartcity development - UnderstandingtheuseofBlockchaininFintech			
UnitNo.	CourseContent			Hours
TheoryComponent				
UnitI	IntroducingBlockchain StructureofBlockchain-BlockchainApplications-BlockchainLife Cycle-Driving Force of Blockchains-Blockchains in Use-Picking a Blockchain-Adding Substance-Determining Needs-Defining Goals-Choosing a Solution-Getting Hands-onBlockchain-DivingintoBlockchainTechnology-Securingand ExchangingYourCryptocurrency			9
UnitII	BeholdingtheBitcoinBlockchain Bitcoin:TheNewWildWest-EncounteringtheEthereumBlockchain-Hacking a Blockchain - Hacking a Blockchain- Creating Your Own ERC20 Tokens			9
UnitIII	GettingyourHandsonHyperledger Working with HyperledgerBesu - Applying Microsoft Azure - Building in the Azure Ecosystem- Deploying Blockchain Toolson Azure- Getting Started with Chain on Azure			9
UnitIV	FinancialTechnology Future Banking Trends-Global Financial Products-Squeezing Out Fraud-Real Estate Innovations-Eliminating Title Insurance-Mortgages in the Blockchain World-Forecasting Regional Trends			9
UnitV	TailoringCoverage InternetofThingsinInsurance-RemovingThirdParties-GlobalRegulatory Landscape-SmartCitiesinAsia-FinancialCapitalCompetition-BorderSecurity			9
PracticalComponent				

Exercises	1. ImplementBlockchainwithGeth 2. SimulatingBlockchainLifeCyclewithGanache 3. Studythevariouscryptocurrenciesandprepareareportonthesame 4. CreateawalletusingOpenSource tools 5. Analyzingtransactions,blocks,andnetworkactivityontheBitcoinblockchain 6. Understanding the volatility, market trends, and trading patterns of Bitcoin 7. ImplementingHyperledgerBesuonAzureUsingOpenSource Software 8. SettingupaHyperledgerFabricnetwork 9. Createasimpleblockchainapplication 10. Studythevariousblockchainsystemsusedbyvariousstategovernments in India and prepare a report on the same	30
Print Resources	1. Tina Laurence, Blockchain for dummies, Jonn Wiley & Sons, 2023. 2. Lorne Lantx, Daniel Cawrey, “Mastering Blockchain”, O’Reilly Media, 2020	

Year: IV	Course code:		Credits	4
Semester: VII	Course Title:	Artificial Intelligence and Machine Learning	Hours	45
			Category	C
Course Prerequisites	Knowledge of Algorithms and Python programming			
Course Outcomes	- Understand the basic concepts, principles, and techniques of artificial intelligence and machine learning - Develop critical thinking and problem-solving skills in the context of AI and ML - Apply AI and ML techniques to solve real-world problems in various domains - Gain hands-on experience implementing and experimenting with AI and ML algorithms and models Learn the unsupervised algorithms			
Theory Component				
Unit-No	Content		Hours	
Unit-I	Overview of Artificial Intelligence History-goals-applications. Intelligent agents: Perception-reasoning-action. Problem-solving techniques: Search algorithms - heuristic search- game playing.		9	
Unit-II	Knowledge Representation and Reasoning Logical agents- Propositional logic- first-order logic. Knowledge representation: Semantic networks- frames. Inference: Resolution-forward chaining- backward chaining- Statistical reasoning.		9	
Unit-III	Python libraries Introduction-NumPy, Pandas, Scikit learn - Machine learning with Python – Cleaning up, Wrangling, Analysis, Visualization- Matplotlib package-Plotting Graphs.		9	
Unit-IV	Machine Learning Fundamentals Introduction to machine learning: Types of learning- supervised - unsupervised learning. Linear regression- Classification: Logistic regression-decision trees- KNN-SVM. Ensemble methods (random forest, gradient boosting). Model selection and evaluation- Implementing Machine Learning algorithms in Python		9	
Unit-V	Unsupervised Learning Clustering algorithms: K-means, hierarchical clustering . Dimensionality reduction: Principal component analysis (PCA). Model selection and evaluation.		9	
Recommended Learning Resources				

Print Resources	Text Books: 1. Stuart Russell and Peter Norvig, "Introduction to Artificial Intelligence", 4th Edition, Pearson, 2021 2. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow", Third Edition, Shroff/O'Reilly, 2022
	Reference: 1. Rich, Knight & Nair – <i>Artificial Intelligence</i> 2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2016.

Practical Component		
Title of the Practical: Artificial Intelligence and Machine Learning		
Ex.No	Exercises	Hours
1	Implement the Water-Jug problem using BFS and DFS approaches	30
2	Implement the A* and AO* algorithms for the Travelling Salesman Problem	
3	Implement the Alpha-Beta Pruning algorithm to play the Tic-Tac-Toe game	
4	Implement unification and resolution for real-world problems	
5	Implement linear regression using Python.	
6	Build and evaluate classification models using KNN and SVM	
7	Implement Ensemble Learning with Random Forests	
8	Implement clustering algorithms in Python.	
9	Implement Dimensionality Reduction with PCA.	
10	Apply AI/ML techniques to solve a real-world problem	
Tools/Software to be used		Python 3.13(64bit)

Year:IV	Course code:		Credits	4
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Semester: VIII	Course Title:	5G Communication Technologies-MJD-19	Hours	75
			Category	C
Course Prerequisites	Knowledge of computer networks and wireless communication networks			
Course Outcomes	● Understand the fundamentals of 5G Architecture ● Understand the basics of 5G Communication ● Understand the various 5G radio-access technologies ● Understand the various 5G Enabling Technologies ● Learn about the 5G use cases			
Theory Component				
Unit-No	Content			Hours
Unit-I	Background Introduction to Cellular Technologies: Frequency reuse, Handoff, Capacity; Evolution of 1G, 2G, 3G, 4G standards and architectures. Propagation mechanisms: Doppler spread, Delay spread, Coherence time and bandwidth, all types of fading (non-detail study alone).			9
Unit-II	5G Architecture: Introduction – 5G Architecture options – 5G Core Network Architecture – 5G RAN Architecture – Network Slicing – 5G physical Layer – 5G Multiple Access Principle – Physical channels and signals – frame structure – Channel structures and beamforming basics – Random Access – Downlink and Uplink User Data transmission			9
Unit-III	5G Radio Access Technologies: Access design principles for multi-user communications, Orthogonal multiple-access systems, Spread spectrum multiple access systems, Capacity limits of multiple-access methods, OFDM numerology for small-cell deployments, Radio access for dense deployments, Radio access for V2X communication.			9
Unit-IV	5G Enabling Technologies MIMO: Introduction – Single User and Multi user MIMO – Capacity of Massive MIMO – Resource allocation and transceiver algorithms – Channel models – mmWave – Channel Propagation – Hardware Technologies – Architecture and mobility – Beamforming – Physical layer techniques.			9
Unit-V	5G Use Cases Machine type communication: Fundamental techniques, Massive MTC, Ultra-reliable low-latency MTC. Device to Device Communication: Radio resource management for mobile broadband D2D, Multi-hop D2D communications for proximity and emergency services, Multi-operator D2D communication.			9
Recommended Learning Resources				

Print Resources	Text Books: 1. Theodore S. Rappaport, “Wireless communications: principles and practice”, Cambridge University Press, 2024. [Unit 1] 2. Osseiran, Afif, Jose F. Monserrat, and Patrick Marsch, “5G mobile and wireless communications technology”, 1st edition, Cambridge University Press, 2016.
	Reference: 1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, 1st Edition, Wiley, 2015. 2. HarriHolma, AnttiToskala, Takehiro Nakamura, “5G Technology 3GPP New Radio”, First Edition, John Wiley & Sons,2020.

Practical Component		
Title of the Practical: 5G Communication Technologies		
Ex.No	Exercises	Hours
1	Study and simulation of Handoff techniques	15
2	Study and simulation of types of fading	
3	Computation of channel capacity	
4	Calculation of bandwidth of different generations	
5	5G Communications Link Analysis with Ray Tracing	
6	Problems based on 5G Frame Structure	
7	Model and analyse 5G NR Waveforms generation	
8	Channel modelling in 5G	
9	MIMO Wireless System Design for 5G	
10	5G Beamforming Design	
Tools/Software to be used		MATLAB / Python

Year: IV	Course code:		Credits	4
Semester: VIII	Course Title:	Hadoop Ecosystem-MDJ-19	Hours	75
			Category	C

Course Prerequisites	Knowledge of Big Data Technologies	
Course Outcomes	• Understand Hadoop ecosystem basics • Build & run simple MapReduce programs • Manage data in HDFS • Apply Hadoop ecosystem tools for data analysis • Understand HiveQL and HBase	
Theory Component		
Unit-No	Content	Hours
Unit-I	Introduction Building Data Analytic Systems with Hadoop - Need for Distributed Analytical System - AI Technologies, Cognitive Computing, Deep Learning and Big Data Analysis, Natural Language Processing and BDAs - SQL and NoSQL Querying - Building BDA systems - Hadoop Ecosystem Implementation - Architecture - Data Visualization and Reporting	9
Unit-II	MapReduce Introduction - Data Format and A Weather Dataset - Analyzing the Data with Unix Tools and Hadoop - Map and Reduce Functions - Java MapReduce - Scaling Out - Hadoop Streaming and Pipes - Map Reduce working Principle	9
Unit-III	Hadoop Distributed File System Design and Concepts of HDFS - Blocks, Namenodes, Datanodes - Command- Line Interface Hadoop File systems - Java Interface - Data Flow – Parallel copying - Hadoop Archives	9
Unit-IV	Advanced MapReduce Development: Configuration and Development Environment - Writing Unit Tests for Map Reduce Running locally on test data - Running on cluster- Tuning a job – Map Reduce workflow - Map Reduce Types and Formats	9
Unit-V	Hadoop Ecosystem for Data Warehousing and Analysis Pig Basics and Running Pig Scripts- Pig Latin - User Defined Functions- Data Processing operators - Hive - HiveQL - HBase Basics - HBase versus RDBMSH Base Use cases	9
Recommended Learning Resources		

Print Resources	Text Books: 1. Kerry Koitzsch, "Pro Hadoop Data Analytics: Designing and Building Big Data System Using the Hadoop Ecosystem", Apress, 2017. 2. Tom White, "Hadoop: The definitive guide", 3 rd Edition, O'Reilly Media, 2012.	
	Reference: 1. Julia H. Allen, "Software Security Engineering: A Guide for Project Managers", 1 st edition, 2008.	

Practical Component		
Title of the Practical: Hadoop Ecosystem		
Ex.No	Exercises	Hours
1.	Simulate Big Data & Explore Hadoop (Single Node)	
2.	Analyse HDFS Architecture (Commands & Fault Tolerance)	
3.	Load Data Techniques (Manual, Flume, Sqoop)	
4.	Build & Optimize MapReduce Job (e.g. Word Count)	
5.	Simulate YARN Resource Management	
6.	Run Sample App on YARN	
7.	Explore HiveQL for Data Analysis	
8.	Explore Pig Latin for Data Processing	
9.	Use Sqoop for Relational Database Import	
10.	Flume for Data Ingestion into HDFS	
Tools/Software to be used		Star UML

Year: IV	Course code:		Credits	4
Semester: VIII	Course Title:	High Performance Computing-MJD-20	Hours	75
			Category	C
Course Prerequisites	Knowledge of Computer Architecture and Cloud Computing			
Course Outcomes	- Understand the historical context, structure, and broad impact of super computing - Grasp key features and enabling technologies shaping HPC systems Apply parallel algorithms such as Fork-Join and Divide and Conquer in HPC systems - Analyze components such as Amdahl’s Law and memory hierarchy in Symmetric multi process or setups - Examine case studies like Open MPAPI and Open ACC to understand their applications in HPC			
Theory Component				
Unit-No	Content		Hours	
Unit-I	Introduction Introduction: High Performance Computing Discipline History of Supercomputing – Anatomy of Supercomputer- Impact of Supercomputing on Science– Society and Security.		9	
Unit-II	HPC Architecture: Systems and Technologies Key Properties of HPC Architecture- Enabling Technology- Vector and Pipelining Single - Instruction Multiple Data Architecture Multiprocessors Heterogeneous Computer Structures.		9	
Unit-III	Parallel Algorithm Introduction, Fork-Join – Divide and Conquer – Manger - Worker– Halo Exchange- Permutation: Cannon’s Exchange – Task Dataflow: Breath First Search.		9	
Unit-IV	Symmetric Multiprocessor Architecture Amdahl’s Law Plus – Processor Core Architecture Memory Hierarchy-PCI Bus-External I/O Interfaces.		9	
Unit-V	Case Studies Open MPAPI, Essential API, Open ACC		9	
Recommended Learning Resources				
Print Resources	1. Thomas Sterling, Matthew Anderson, MaciejBrodowicz, "High Performance computing” Morgan Daufmann, 2017 2. Severance, Charles and Kevin Dowd, “High Performance Computing”, OpenStax CNX, 2015.			

Practical Component		
Title of the Practical: High Performance Computing		
Ex.No	Exercises	Hours
1.	Install MPICH library and write a "Hello World" program	
2.	Write a parallel program to calculate the value of PI/Area of Circle using OpenMP library	
3.	Write a parallel program to multiply two matrices using MPI library and compare the execution time with it'sOpenMP and Serial version	
4.	Write a program in C to multiply two matrices of size 10000 x 10000 each and find it's execution-time using "time" command. Try to run this program on two or more machines having different configurations and compare execution-times obtained in each run. Comment on which factors affect the performance of the program	
5.	Install MPICH on two and more machines and create a MPI cluster. Execute MPI programs on this cluster and check the performance.	
6.	Implement a program to demonstrate balancing workload on MPI platform	
Tools/Software to be used		

Year	IV	Course Code:	Credits	4
Sem.	VIII	Course Title: Data Center Management-MJD-20	Hours	75
			Category	A
Course Prerequisites if any	● Knowledge of Computer Networks and Cloud Computing			
Course Outcomes	● To understand how to manage a data center environment ● To learn and keep track of the reporting system and adapt to changes in the system ● To provide effective management in Client server environment ● To analyze the data center processes and operations in distributed network ● To develop and Test			
Theory Component				
Unit-No	Content			Hours
Unit-I	Data Center Management Cost-Effective Management Practices for the Data Center - The Outsourcing Alternative - Downsizing Computer Resources - Fine Tuning the Help Desk - Achieving Quality in Data Center Operations - Automating the Data Center.			9
Unit-II	Data Center Controls Developing a Data Center Reporting System - Update on Change Control and Problem Tracking Systems - Improving Productivity, File Retention and Backup - Understanding Computer Negligence and Liability.			9
Unit-III	Systems Planning Client/Server Technology - Managing Hardware – Implementing Client/Server Solutions – Implementation of Business Process Reengineering - Three Client/Server Implementations.			9
Unit-IV	Network Technology Enterprise Network Design Technology - Managing Multi Network Communications - Securing Distributed Data Networks - Distributed Network Security - The Data Center Manager’s Guide to Ensuring LAN Reliability and Availability - Auditing LANs.			9
Unit-V	Contingency Planning Overview of Business Continuity Planning - Strategies for Developing and Testing - A Business Impact Analysis for Disaster Recovery - Network Disaster Recovery Planning, Disaster Recovery Planning Tools and Management Options.			9
Recommended Learning Resources				
Print Resources	Text Books: 1. Layne C. Bradley , “Handbook of Data Center Management”, 2nd Edition, CRC Press, 2018. 2. HwaiyuGeng ,”Data Center Handbook- Plan, Design, Build, and Operation of a Smart Data Center”, Wiley, 2021.			

Practical Component		
Title of the Practical: Data Center Management		
Ex.No	Exercises	Hours
1	Perform a study of data center management tools and prepare a report on the same	30
2	Perform a study of network security and prepare a report on the same	
3	Perform a study of disaster recovery tools for Data Center Management and prepare a report on the same	
4	Perform a study of Business Continuity Planning tools and prepare a report on the same	
5	Perform a study of Business Continuity Standards and prepare a report on the same	
6	Perform a study of DR Standards and prepare a report on the same	
7	Perform a study of data centers of any 5 Banks and prepare a report on the same	
8	Perform a study of data centers of Service Providers and prepare a report on the same	
9	Perform a study of state data centers of 5 Indian states and prepare a report on the same	
10	Perform a study of Meghraj Project and prepare a report on the same	
Tools/Software to be used	Case study	

Year	IV	Course Code:	Credits	4
Sem.	VIII	Course Title : Drone Technologies-MJD-21	Hours	75
			Category	A
Course Prerequisites if any	● Knowledge of computers and mobile devices			
Course Outcomes	● Understand the evolving landscape of drone technology and its current and potential applications ● Develop proficiency in utilizing drone data visualization as a comprehensive tool throughout its full cycle ● Understand the AEC drone operations, including standard features, software applications, legal regulations, and permissions ● Develop comprehensive knowledge and skills in drone operation best practices, app usage, and automated techniques ● Apply the knowledge and skills for proficiently utilizing drones for photogrammetry applications			
Theory Component				
Unit-No	Content		Hours	
Unit-I	Fundamentals Introduction- The Breadth of Drone Applications- Basic Drone Use- Current Breadth of Drone Use- The Future Breadth of Drone Use - The Risks of Drone Technology- The Bottom Line on Drones.		9	
Unit-II	Drone Data Visualization as a Full Cycle Tool Drone Data Visualization-Advantages-Defining Drone Data and Visualization - 2D Concept Overlay- 3D Concept Model Overlay- Return on Investment (ROI) - Rate of Return (ROR) -Value Added Services- Training Costs- Permissions Costs.		9	
Unit-III	Getting Started with Foundations of AEC Drone Operations: Documentation, Permissions, and License AEC Drone Standard Features -Drone Packages- Applications and Software Desktop Software- Computer Hardware- Documentation, Permissions and License.		9	
Unit-IV	Best Practices for Flying Drones The Flying Mindset - Drone Flying Apps- Automated Flying- Acquiring and Working with Drone Data: Imagery and Videos- Photo and Video Quality- Using DJI Standard Apps- Image Geotag- Litchi Flight Planning Software- Working with Drone Photos- Working with Drone Videos.		9	

Unit-V	Photogrammetry Drones and Photogrammetry- Photogrammetry Accuracy and Precision Ground Control Points- Collecting Data- RTK Drones, Ground Control Pads Processing the Data- Processing Steps- Photogrammetry Hardware Photogrammetry Software- Working with 3D Models- Working with Point Clouds and 3D Meshes - Future of UAVs.	9
Recommended Learning Resources		
Print Resources	Text Books: 1. Daniel Tal and Jon Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, First edition, 2021. 2. Aaron Asadi, “Drones The Complete Manual: The Essential Handbook for Drone Enthusiasts”, First edition, Imagine Publishing Ltd, 2016 (ISBN 978 1785 462 962)	

Practical Component		
Title of the Practical: Drone Technologies		
Ex. No	Exercises	Hours
1	Study on drone and their types	30
2	Disassemble and assemble different parts of the drone for testing and repair	
3	Understand Flight Simulator: Perform basic flight maneuvers	
4	Capturing agricultural fields using drones to identify the status of the crops	
5	Collecting Atmospheric pressure, air quality, temperature, and humidity to identify the purity of the air in the atmosphere	
6	Testing of landing gear	
7	Testing of the GPS module	
8	Testing of Collision avoidance sensor	
9	Testing of different motors and flight controllers	
10	Sending and receiving messages from the drone to the ground system	
Tools/Software to be used		

Year: IV	Course code:		Credits	4
Semester: VIII	Course Title:	Modern Networking-MJD-22	Hours	75
			Category	C
Course Prerequisites	Knowledge of Computer Networks			
Course Outcomes	• Understand the fundamentals of modern networking, including the networking ecosystem, network architectures • Learn about the concepts and architecture of SDN and NFV • Learn about SDN and NFV including their approaches, integration, and related standards • Learn about Network Virtualization • Learn about Cloud computing and IoT			
Theory Component				
Unit-No	Content			Hours
Unit-I	Introduction to Modern : The Networking Ecosystem- Example Network Architectures- Network Convergence- Unified Communications - Requirements and Technology- Types of Network and Internet Traffic- Emerging Demands- Quality of Service (QoS) and Quality of Experience (QoE)- Routing Characteristics- Congestion Control- Software-Defined Networking (SDN) and Network Function Virtualization (NFV)- Modern Networking Elements.			9
Unit-II	Introduction to Software-Defined Networks (SDN): The SDN Approach- SDN and NFV Integration- Related Standards in SDN and NFV- SDN Control Plane- SDN Application Plane Architecture- Measurement and Monitoring in SDN- Security in SDN Environments- SDN in Data Centre Networking- Mobility and Wireless Aspects in SDN- Information-Centric Networking (ICN)			9
Unit-III	Network Functions Virtualization: Concepts and Architecture Background and Motivation- Virtual Machines- NFV Concepts- NFV Benefits and Requirements- NFV Reference Architecture- NFV Functionality- NFV Infrastructure- Virtualized Network Functions- NFV Management and Orchestration- NFV Use Cases- SDN and NFV			9

Unit-IV	Network Virtualization: Virtual LANs- OpenFlow VLAN Support- Virtual Private Networks- Network Virtualization- OpenDaylightVirtualTenant Network- Software Defined Infrastructure. Quality of Service- Background- QoS Architectural Framework Integrated Services Architecture- Differentiated Services- Service Level Agreements- IP Performance Metrics- OpenFlowQoS Support.	9
Unit-V	Cloud Computing: Basic Concepts- Cloud Services- Cloud Deployment Models- Cloud Architecture- SDN and NFV- The Internet of Things: Components- The IoT Era Begins- The Scope of the IoT- Components of IoT-Enabled Things- IoT Architecture- IoT Implementation.	9
Recommended Learning Resources		
Print Resources	Text Books: 1. Stallings, W, “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud”, Addison-Wesley Professional, 2015. 2. Goransson, Paul, Chuck Black, and Timothy Culver, “Software defined networks: a comprehensive approach “, Morgan Kaufmann, 2016.	
	Reference: 1. Ken Gray, Thomas D. Nadeau, “Network Function Virtualization (NFV): Concepts and Applications”, Morgan Kaufmann, First Edition, 2016	

Practical Component		
Title of the Practical: Modern Networking		
Ex.No	Exercises	Hours
1	Analyze network and internet traffic using Wireshark	45
2	Implement unified communications with Asterisk	
3	Deploy OpenDaylight or ONOS SDN controller	
4	Explore SDN and NFV standards compliance using OpenDaylight and OPNFV	
5	Deploy virtual machines using tools like KVM (Kernel-based Virtual Machine) or VirtualBox to simulate NFV environments	
6	Implement a reference NFV architecture using OPNFV (Open Platform for NFV) or OpenStack	
7	Set up a VPN tunnel using OpenVPN or StrongSwan to establish secure communication over a virtualized network	

8	Configure OpenFlow switches to support VLANs using Mininet and Floodlight/OpenDaylight controllers	
9	Deploy and explore basic cloud computing concepts using OpenStack or Apache CloudStack	
10	Deploy different cloud deployment models (public, private, hybrid) using OpenStack or OpenNebula	
Tools/Software to be used		