

KONERU LAKSHMAIAH EDUCATION FOUNDATION

MASTER OF COMPUTER APPLICATIONS

**PROGRAMME
CURRICULUM
2025-2026**

MCA PROGRAM STRUCTURE

SEM -1

SEM NO.	CATEGORY	COURSE CODE	COURSE TITLE	SHORT NAME	MODE	L	T	P	S	CR	CH	PRE-REQUISITE	SPECIALISATIONS
1	PCC	23CA5101O	Computer Networks And Communications	CNC	R	3	0	2	0	4	5	NIL	COMMON
1	PCC	23CA5102O	Data Structures and Algorithms	DSA	R	3	0	2	4	5	9	NIL	
1	AUC	23UC5201O	Professional Communication Skills	PCS	R	0	0	4	0	0	4	NIL	
1	PCC	24CA5103O	Operating Systems Concepts	OSC	R	3	1	0	0	4	4	NIL	
1	PCC	23CA5104O	Database Systems	DBS	R	3	0	2	4	5	9	NIL	
TOTAL										18	31	NIL	

SEM -2

SEM NO.	CATEGORY	COURSE CODE	COURSE TITLE	SHORT NAME	MODE	L	T	P	S	CR	CH	PRE-REQUISITE	SPECIALISATIONS
2	PCC	23CA5205O	Object Oriented Programming	OOP	R	3	0	2	4	5	9	NIL	COMMON
2	PCC	23CA5206O	Data Analytics	DA	R	3	0	2	0	4	5	NIL	
2	PCC	23CA5207O	Comprehensive Software Engineering	CSE	R	2	1	0	0	3	3	NIL	
2	PEC	23CA52A1O	Applied Machine Learning (PE 1)	AML	R	3	0	2	4	5	9	NIL	ARTIFICIAL INTELLIGENCE
2	PEC	23CA52A2O	Pattern Recognition (PE2)	PR	R	3	0	0	0	3	3	NIL	
2	PEC	23CA52C1O	Cloud Computing (PE 1)	CC	R	3	0	2	4	5	9	NIL	CLOUD COMPUTING
2	PEC	23CA52C2O	Cloud Information Security (PE2)	CIS	R	3	0	0	0	3	3	NIL	
2	PEC	23CA52S1O	Cyber Security And Ethical Hacking (PE 1)	CSEH	R	3	0	2	4	5	9	NIL	CYBER SECURITY
2	PEC	23CA52S2O	Cyber Forensics (PE2)	CF	R	3	0	0	0	3	3	NIL	
2	PEC	23CA52A1O	Applied Machine Learning (PE 1)	AML	R	3	0	2	4	5	9	NIL	DATA SCIENCE
2	PEC	23CA52D2O	HADOOP AND BIGDATA (PE2)	HAD	R	3	0	0	0	3	3	NIL	
TOTAL										44	65	NIL	

SEM -3

SEM NO.	CATEGORY	COURSE CODE	COURSE TITLE	SHORT NAME	MODE	L	T	P	S	CR	CH	PRE-REQUISITE	SPECIALISATIONS
3	PCC	23CA6108O	WEB TECHNOLOGIES	WT	R	3	0	2	4	5	9	NIL	COMMON
3	PRI	23IE5201O	ESSENTIALS OF RESEARCH DESIGN	ERD	R	1	1	0	0	2	2	NIL	
3	PEC	23CA61A3O	Computer Vision (PE 3)	CV	R	3	0	2	4	5	9	NIL	ARTIFICIAL INTELLIGENCE
3	PEC	23CA61A4O	Applied Deep Learning (PE 4)	ADL	R	3	0	0	0	3	3	NIL	
3	PEC	23CA61A5O	Applications of Natural Language Processing (PE 5)	ANLP	R	3	0	2	0	4	5	NIL	CLOUD COMPUTING
3	PEC	23CA61C3O	Cloud Architectures (PE 3)	CA	R	3	0	2	4	5	9	NIL	
3	PEC	23CA61C4O	Cloud and Serverless Computing (PE 4)	CSC	R	3	0	0	0	3	3	NIL	
3	PEC	23CA61C5O	Cloud Web Services (PE 5)	CWS	R	3	0	2	0	4	5	NIL	CYBER SECURITY
3	PEC	23CA61S3O	Malware Analysis (PE 3)	ML	R	3	0	2	4	5	9	NIL	
3	PEC	23CA61S4O	Security Governance and Management (PE 4)	SGM	R	3	0	0	0	3	3	NIL	
3	PEC	23CA61S5O	Cloud Security (PE 5)	CS	R	3	0	2	0	4	5	NIL	DATA SCIENCE
3	PEC	23CA61D3O	DATA VISUALIZATION TECHNIQUES (PE 3)	DVT	R	3	0	2	4	5	9	NIL	
3	PEC	23CA61D4O	STATISTICS FOR DATA SCIENCE (PE 4)	SDS	R	3	0	0	0	3	3	NIL	
3	PEC	23CA61D5O	GRAPH AND WEB ANALYTICS (PE 5)	GWA	R	3	0	2	0	4	5	NIL	INT & Term Paper
3	PRI	24IE6101O	INTERNSHIP	INT1	R	0	0	6	0	3	6	NIL	
3	PRI	24IE6102O	Term Paper	TP	R	0	0	4	0	2	4	NIL	
TOTAL										60	89	NIL	

SEM -4

SEM NO.	CATEGORY	COURSE CODE	COURSE TITLE	SHORT NAME	MODE	L	T	P	S	CR	CH	PRE-REQUISITE	SPECIALISATIONS
4	PRI	24IE6203O	PROJECT	PRO		0	0	20	0	10	20	NIL	OEC & PROJECT
4	OEC	OEBT0001O	IPR AND PATENT LAWS (OE1)	IPR	R	3	0	0	0	3	3	NIL	
4	OEC	O EIN0001O	Fundamentals of IOT (OE2)	FIOT	R	3	0	0	0	3	3	NIL	
TOTAL CREDITS										16	26	NIL	
TOTAL CREDITS										138	211		

SEM-1

COMPUTER NETWORKS AND COMMUNICATIONS

(23CA5101O)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA5101O	COMPUTER NETWORKS AND COMMUNICATIONS	CNC	R	3	0	2	0	4

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand the fundamentals of computer networks and data communication 2	2
CO2	Understand Data Link Layer, IEEE Standards, design issues in networks 2	3
CO3	Analyze Internet Transport Protocols and different types of protocols 4	4
CO4	Analyze various types of Network Devices and different types of Networks 4	4
CO5	Evaluate the concepts of computer network applications using Cisco Packet Tracer and Python	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	3				
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		3	3		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.				3	

PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing					3
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Syllabus:

Introduction to Computer Networks: Introduction, Network Hardware, Network Software, Reference Models, Data Communication Services & Network Examples, Internet Based Applications. Data Communications: Transmission Media, Wireless Transmission, Multiplexing, Switching, Transmission in ISDN, Broad Band ISDN, ATM Networks Data Link Control, Error Detection & Correction, Sliding Window Protocols, LANs & MANs: IEEE Standards for LANs & MANs- IEEE Standards 802.2, 802.3, 802.4, 802.5, 802.6, High Speed LANs. Design Issues in Networks: Routing Algorithms, Congestion Control Algorithms, Network Layer in the Internet, IP Protocol, IP Address, Subnets, and Internetworking. Internet Transport Protocols: Transport Service, Elements of Transport Protocols, TCP and UDP Protocols, Quality of Service Model, Best Effort Model, Network Performance Issues. Overview of DNS, SNMP, Electronic Mail, FTP, TFTP, BOOTP, HTTP Protocols, World Wide Web, Firewalls. Network Devices: Overview of Repeaters, Bridges, Routers, Gateways, Multiprotocol Routers, routers, Hubs, Switches, Modems, Channel Service Unit CSU, Data Service Units DSU, NIC, Wireless Access Points, Transceivers, Firewalls, Proxies. Overview of Cellular Networks, Ad-hoc Networks, Mobile Ad-hoc Networks, Sensor Networks

Reference Books:

- 1) Computer Networks, Andrews S Tanenbaum , 5th Edition, 2010, Pearson.
- 2) Data Communications and Networking, Behrouz A Forouzan , 2nd Edition, 2017, McGraw-Hill Education.
- 3) Computer Networks, A System Approach, Larry L Peterson and Bruce S Davie, 5th Edition, 2011, Pearson.
- 4) An Engineering Approach to Computer Networks, S.Keshav, 2nd Edition, 2002, Pearson.
- 5) Understanding Communications and Networks, W.A. Shay, Thomson, 3rd Edition, 2004, Pearson.

DATA STRUCTURES AND ALGORITHMS

(23CA5102O)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA5102O	DATA STRUCTURES AND ALGORITHMS	DSA	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand the concept of structures to store multiple data values like arrays, pointers	2
CO2	Classify different data structures in Linear data structures	2
CO3	Design and develop solutions to performing operations on binary search trees	3
CO4	Analyse and implement various searching and sorting techniques	4
CO5	Evaluate applications using control structures for linear and non-linear data structures	5
CO6	Assess the data structure for its functions based on performance metrics.	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2			3		
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		3	3			3
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized			2	2	3	2

Syllabus:

Introduction to Data Structures: Algorithms and Flowcharts, Basics Analysis on Algorithm, Complexity of Algorithm, Introduction and Definition of Data Structure, Classification of Data, Arrays, Various types of Data Structure, Static and Dynamic Memory Allocation, Function, Recursion. Arrays, Pointers and Strings: Introduction to Arrays, Definition, One Dimensional Array and Multidimensional Arrays, Pointer to Structure, various Programs for Array and Pointer. Strings. Introduction to Strings, Definition, Library Functions of Strings." Linked Lists and Trees: Introduction, Representation and Operations of Linked Lists, Singly Linked List, Doubly Linked List, Circular Linked List, And Circular Doubly Linked List. Stacks and Queue :- Introduction to Stack, Definition, Stack Implementation, Operations of Stack, Applications of Stack and Multiple Stacks. Implementation of Multiple Stack Queues, Introduct Queue: Queue, Definition, Queue Implementation, Operations of Queue, Circular Queue, De-queue and Priority Queue Trees: Introduction to Tree, Tree Terminology Binary Tree, Binary Search Tree, strictly. Binary Tree, Complete Binary Tree, Tree Traversal, Threaded Binary Tree, AVL Tree, B Tree, B+ Tree Graphs: Introduction, Representation to Graphs, Graph Traversals Shortest Path Algorithms. Searching and Sorting: Searching, Types of Searching, Sorting, Types of sorting like quick sort, bubble sort, merge sort, selection sort. Hashing: Hash Function, Types of Hash Functions, Collision, Collision Resolution Technique (CRT), Perfect Hashing"

Reference Books:

- 1) Data structures, Tata McGraw-Hill, 2017, McGraw Hill Education
- 2) Data Structures, E. Balagurusamy, 2017, McGraw Hill Education
- 3) Algorithms II, Robert Sedgewick and Kevin Wayne, 2014, Pearson Education
- 4) Introduction to Algorithms, Thomas H.Cormen,Charles E.Leiserson, 1989, Prentice-Hall.
- 5) Design and Analysis of Algorithms, S.Sridhar, 2014, Oxford Unioversity Press

PROFESSIONAL COMMUNICATION SKILLS

(23UC52010)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23UC52010	PROFESSIONAL COMMUNICATION SKILLS	PCS	R	0	0	4	0	0

Course Outcomes:

CO#	CO Description	BTL
CO1	To develop and demonstrate principles of listening, speaking, reading and writing in various functional contexts	3
CO2	To demonstrate different types of personal and professional skills and apply them for growth in professional zone.	3
CO3	Apply the concepts of Mathematical Principles to solve problems on Arithmetic, Algebra & Geometry to improve problem solving ability.	3
CO4	Apply the concepts and using Logical thinking to solve problems on verbal & Non-Verbal Reasoning to develop Logical thinking skills.	3

Syllabus:

Module 1	A)Vocabulary: Synonyms, Antonyms and One-word substitutes, (B)Reading comprehension, Critical reading, (C) Writing skills: Email writing, report writing and paragraph writing (D) Listening/Speaking Skills: listen & speak, Functional grammar
Module 2	A. Personal Skills: Intra & Interpersonal skills (B) Assertiveness (C) Group Discussion (D) Resume writing (E) Video resumes (F) Interview skills
Module 3	Simple Equations, Ratio & Partnership, Averages, Percentages, Profit & Loss, Simple & Compound Interest, Numbers, Quadratic Equations & Inequalities, Time & Work, Time, Speed & Distance, Permutations & Combinations, Probability, Mensuration, Data Interpretation.
Module 4	Syllogism, Logical Venn Diagrams, Cubes & Dice, Number& letter series, Number, letter & word Analogy, Odd Man Out, Coding & Decoding, Blood Relations, Directions, clocks, calendars, Number, ranking & Time sequence test, Seating Arrangements, Data Sufficiency.

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	The Business Student's Handbook: Skills for Study and Employment	Fisher, Julie and Bailey, Peter	Cengage Learning	2017
2	The Complete Guide to mastering soft skills for workplace success	Adams, John	Adams media	2019
3	Writing Tools: 55 Essential Strategies for Every Writer	Roy Peter Clark	Little, Brown and Company	2006
4	Quantitative Aptitude	R. S. Agarwal	SCHAND	
5	A Modern Approach to Verbal Reasoning	R. S. Agarwal	SCHAND	

OPERATING SYSTEMS CONCEPTS

(24CA5103O)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
24CA5103O	OPERATING SYSTEMS CONCEPTS	OSC	R	3	1	0	0	4

Course Outcomes:

CO#	CO Description	BTL
CO1	Demonstrate the working of an operating system and its functionalities and different types of OS	2
CO2	Classify the stages of the process and CPU Scheduling algorithms	2
CO3	Identify the concept of process synchronization and its applications.	3
CO4	Organise the memory management concept and different strategies with the scenario of the file system.	3

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	3		
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized			3	2

Syllabus:

What is an OS, Brief history, Functionalities of OS,. Basics Computer System Architecture overview. Operating System Structures, Types of Different OS, Basic Oss: Batch, Multi-programmed batch, Timesharing, Real-Time OS (RTOS), Distributed OS. Processes: Definition, Process States, 5 state model, Process structure: PCB and components, Interprocess Communication, Operations on Processes, Threads, CPU Scheduling: I/O burst cycle, Context Switching, Short Term, Long Term and Scheduling Criteria, Algorithms: First Come First Serve, Shortest Job First, Priority Scheduling, Round Robin. Process

Synchronization: Critical Section Problem, Mutual Exclusion, Races, Semaphores, Classic Synchronization Problems, Readers/Writers, Dining Philosophers. Deadlocks: Deadlocks and Starvation, System Model, Necessary Conditions for a deadlock, Mutual Exclusion, Hold and Wait, No Pre-emption, Circular wait, Resource Allocation Graphs, Handling Deadlocks, Prevention, Avoidance, Bankers Algorithm. I/O Device Management, I/O Device Types and Characteristics. Memory Management: Swapping, Multiple Partition-First Fit-Best Fit-Worst Fit, RAID and Data Redundancy. Fragmentation: Internal and External Fragmentation, Paging and Demand Paging, Page Replacement, Page Replacement Algorithms, Thrashing. File-System: File-System structure, Access Methods, Directory structure, File-System Implementation, Protection.

Reference Books:

- 1) Operating Systems: Internals and Design Principles, William Stallings, 2013, Pearson Education.
- 2) Modern Operating Systems, Andrew S. Tanenbaum and Herbert Bos, 2014, Pearson Education.
- 3) Windows Internals, Mark Russinovich, David A. Solomon, Alex Ionescu, 2012, Microsoft Press.
- 4) Linux Kernel Development, Robert Love , 2012, Addison-Wesley Professional

DATABASE SYSTEMS

(23CA5104O)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA5104O	DATABASE SYSTEMS	DBS	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	Illustrate Database and File System and Applying different kinds of data models with functional components of DBMS	2
CO2	Demonstrate operations of SQL, PL/SQL and correlating appropriate strategies for optimization of queries with Tuple Relational Calculus and Domain Relational Calculus.	2
CO3	Identify operations of SQL, PL/SQL and correlating appropriate strategies for optimization of queries with Tuple Relational Calculus and Domain Relational Calculus	3
CO4	Apply concurrency techniques to demonstrate the organization of Databases with log mechanism and check pointing techniques for system recovery	3
CO5	Interpret and evaluate variety of methods for effective processing of given queries	5
CO6	Evaluate variety of methods for effective processing of given queries	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	3		2			
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		3				

PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.				3		
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized		2	3	2	3	2
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing					2	3

Syllabus:

Database Design A Historical Perspective, File Systems versus a DBMS, the Data Model, Levels of Abstraction in a DBMS, view of Data, Database Languages, Data Independence, Structure of a DBMS Database Engine, Database and Application Architecture, Database Users and Administrators. Database Design concepts and the E-R Model: Overview of the Design Process, The Entity-Relationship Model, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Conceptual Design with the ER Model, Mapping Cardinalities, Primary Key, Removing Redundant Attributes in Entity Sets, Reducing E-R Diagrams to Relational Schemas, Additional Features of the ER Model Calculus, Domain relational calculus. SQL Data Definition, SQL Data Types and Schemas, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub-queries, Modification of the Database. different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion, Views, Transactions, Indexing and Non-Indexing Refinement of Schema: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms, BCNF, lossless join decomposition, multivalued dependencies, 4NF, 5NF

Managing Transactions, ACID properties, Concurrent Executions, Lock based Concurrency, Locking Performance Controlling Concurrency-Serializability, Recoverability, Lock Based Protocols, Dealing with Deadlocks, Deadlock Handling, Use of Lock Conversions, Crash Recovery ARIES algorithm, The Write A head log Protocol, System Crash Recovery, Storage and indexing- File organization, indexing, Hash based, and Tree based Indexing.

Reference Books:

- 1) Database System Concepts , Abraham Silberschatz, Yale University Henry, F. Korth Lehigh University, S. Sudarshan Indian Institute of Technology, Bombay., 2009, tata mcgraw hill books.
- 2) Fundamentals of Database Systems, Fundamentals of Database Systems, 2001, Pearson.
- 3) An Introduction to Database Systems , Bipin C. Desai, 2001, Galgotia Publications Pvt Ltd.
- 4) Principles of Database Systems, Jeffrey D. Ullman , 1980, Galgotia Publications.
- 5) Database Management Systems, Raghu RamaKrishnan, Johannes Gehrke, 1996, Raghu RamaKrishnan, Johannes Gehrke.

SEM-2

OBJECT ORIENTED PROGRAMMING

(23CA52050)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA52050	OBJECT ORIENTED PROGRAMMING	OOP	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
C01	Understand Principles of OOP and Inheritance	2
C02	Design and Implement interfaces, Packages and Enumeration, Exceptions & Assertions	3
C03	Analyze Multi-Threading and Applets	4
C04	Designing dynamic application programs using event handling, AWT and collections framework	4
C05	Create user interfaces using at package classes	5
C06	experiment the various design techniques and the Object-Oriented Programming concepts	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	3				2	
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		2		2	3	

PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.	2		3			3
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing		3	3	2	2	
PO7	Communication: Communicate effectively in the team and the user to deliver solution and operational procedures with professional standards						3

Syllabus:

Introduction: Principles of Object-Oriented Languages, Applications of OOP Programming
Constructs: Variables, Primitive Data types, Identifiers -Naming Conventions, Keywords, Literals, Operators -Binary, Unary and ternary, Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control -Branching, Conditional, loops. Classes and Objects: Classes, Objects, Creating Objects, Methods, constructors - Constructor overloading, cleaning up unused objects -Garbage collector, Class variable and Methods -Static keyword, this keyword, Arrays, Command line arguments Inheritance: Types of Inheritance, Deriving classes using extends keyword, Method overloading, super keyword, final keyword, Abstract class

Interfaces, Packages and Enumeration: Interface -Extending interface, Interface Vs Abstract classes, Packages -Creating packages, using Packages, Access protection, java.lang package. Exceptions & Assertions: Introduction, Exception handling techniques :try-catch, throw, throws , finally block, user defined exception, Exception Encapsulation and Enrichment, Assertions

Multi-Threading: java.lang.Thread, The main Thread, Creation of new threads, Thread priority, Multithreading - Using isAlive () and join (), Synchronization , suspending and Resuming threads, Communication between Threads Input/Output: reading and writing data, java.io package, Applets - Applet class, Applet structure, An Example Applet Program, Applet : Life Cycle, paint, update and repaint

Event Handling: Introduction, Event Delegation Model, java.awt.event Description, Sources of Events, Event Listeners, Adapter classes, Inner classes. Abstract Window Toolkit: Why AWT?, java.awt package, Components and Containers, Button, Label, Checkbox, Radio buttons, List boxes, Choice boxes, Text field and Text area, container classes, Layouts, Menu, Scroll bar Swing:

Introduction, JFrame, JApplet, JPanel, Components in swings, Layout Managers, Jlist and Scroll Pane, Split Pane, JTabbedPane, Dialog Box Pluggable Look and Feel. File Handling: Stream classes, class hierarchy, useful I/O classes- File Input Stream, File Output Stream Creation of text file, reading and writing text files Collections Framework: Collections Framework overview, Collection classes- Array List, LinkedList, HashSet. The For- Each loop Map class: HashMap

Reference Books:

- 1) Java The Complete Reference 9th Edition, Herbert Schildt, 9, McGraw Hill Education (India) Private Limited.
- 2) Programming with Java, E. Balagurusamy, 3, McGraw Hill Education.
- 3) Java How to Program, Sixth Edition, H.M.Dietel and P.J.Dietel, 6, Pearson Education/PHI.
- 4) "Java: The Complete Reference", Herbert Schildt, 11, McGraw-Hill Education.
- 5) "Java Concurrency in Practice", Brian Goetz, et al., 1, Addison-Wesley.

DATA ANALYTICS

(23CA5206O)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA5206O	DATA ANALYTICS	DA	R	3	0	2	0	4

Course Outcomes:

CO#	CO Description	BTL
CO1	Outline R Programming environment and R Packages.	2
CO2	Experiment with basic statements, control structures and functions in R	3
CO3	Examine the working nature of different data structures and data frame manipulation in R.	4
CO4	Discover data analysis pattern using Statistics and Data visualization	4
CO5	Infer different pattern with data analytics function on data set.	4

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
P01	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	3				
P02	Problem Analysis: Ability to identify computing problem and analyze the		3	3	3	
P03	Design and Development: Design and develop efficient solutions for complex problems across different domains.		3	3	3	
P04	Research: Apply research-based knowledge and methodologies to analyze, design, validate resultand interpret it into optimized					2
P05	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing					3

Syllabus:

Introduction to Data Analytics: What are Data Analytics? Why Data Analytics? , Data basics, Quantitative data : Nominal data, Ordinal data, What is R? Why R? Advantages of R over Other Programming Languages R Studio: R command Prompt, R script file, comments, handling packages in R, installing R package, important commands to get started: `installed.packages()`, `package Description ()`, `help()`, `find. package ()`, `library ()`, Input and Output ,Entering Data from keyboard, Printing fewer digits or more digits.

R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Variables: Variable assignment, Data types of Variable, Finding Variable, Deleting Variables. R Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators, R Decision Making: if statement, break statement, next statement. R Functions: function definition, Built in functions: `mean()`, `paste()`, `sum()`, `min()`, `max()`, `seq()`, user defined functions, calling a function, R Strings : Manipulating text in Data `substr()`, `strsplit()`, `paste()`, `grep()`, `toupper()`, `tolower()`.

R Vectors : Sequence vector, `rep` function, vector access, vector names, vector math, R List : Creating a List, Add/Delete Element to or from a List, Size of List, Merging Lists, Matrix Computations: Addition, subtraction, Multiplication and Division. R Arrays: Accessing Array Elements, Calculation Across Array Elements, R Factors : creating factors, generating factor levels. Basics in Statistics: Descriptive and Inferential, Sample and Population. Data Frames: Create Data Frame, Data Frame Access, Understanding Data in Data Frames: `dim()`, `nrow()`, `ncol()`, `str()`, `Summary()`, `names()`, `head()`, `tail()`, `edit()` functions, Extract Data from Data Frame, Expand Data Frame: Add Column, Add Row - Joining columns and rows in a Data frame `rbind()` and `cbind()`, Merging Data frames merged

Descriptive Statistics: Data Correlation and Causation, Spotting Problems in Data with Visualization: visually Checking distributions for a single Variable, R Pie Charts: Pie Chart title and Colors, Slice Percentages and Chart Legend, 3D Pie Chart, R Histograms , Density Plot, R BarCharts: Bar Chart Labels, Title and Colors. Loading and handling Data in R, Getting and Setting the Working Directory: `getwd()`,`setwd()`, `dir()`, R CSV Files : Input as a CSV file, Reading a CSV File, Analyzing the CSV File: `summary()`, `min()`, `max()`, `range()`, `mean()`, `median()`, `apply()` - Writing into a CSV File, Analyzing the CSV file, R Excel File, Reading the Excel file Range

Reference Books:

- 1) R Programming for Beginners, Sandip Rakshit, 1, McGraw Hill India.
- 2) Data Analytics using R, Seema Acharya, 1, McGraw Hill Education India.
- 3) R for Dummies , Andrie de Vries, JorisMeys, 2, John Wiley and Sons.
- 4) Data Analytics: Concepts, Techniques, and Applications, Mohiuddin Ahmed, Al-Sakib Khan Pathan , 1, CRC press.

COMPREHENSIVE SOFTWARE ENGINEERING

(23CA5207O)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA5207O	COMPREHENSIVE SOFTWARE ENGINEERING	CSE	R	2	1	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand Fundamentals Object Oriented Software Engineering	2
CO2	Develop UML diagrams and process models for Echo Systems.	3
CO3	Design and apply software architectures.	3
CO4	Analyze software testing and software process models	4

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2			
PO2	Problem Analysis: Ability to identify computing problem and analyze the		2	2	
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.		3	3	3
PO6	Project Management: Demonstrate knowledge on project management				2

Syllabus:

Software and Software Engineering, Nature of software, software application domains, unique nature of web applications, software engineering, software process, software engineering practice, SDLC, software myths.

Process Models: Generic process model, prescriptive process models, specialized process models, unified process, personal and team process models, product and process

Reverse Engineering, Agile Development, Agile manifesto and principles, Extreme programming, Scrum, Feature Driven Development (FDD), Lean Software Development (LSD), Requirements Engineering, Requirements classification, Requirements modeling approaches, SRS and User Stories, Analysis to Design, Coupling and Cohesion, Refactoring Design Concepts, Design Principles, Software architecture, architectural styles, Use cases, Classes, Relationships, common Mechanisms and their diagrams. Interfaces, Modeling techniques for Class Et Object Diagrams.

Behavioral Modeling : Interaction diagrams. Activity Diagrams. Software testing Et reliability, A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Testing methods, The Human and The Computer, Golden Rules, user interface analysis and design, interface analysis, interface design steps. Software Process Improvement, Software Quality Assurance: Six Sigma Et the CMMI

Reference Books:

- 1) Object Oriented Software Engineering: Practical Software Development using UML and Java. , Timothy C Lethbridge U Robert, Langaneire, 2014, Mc Graw Hill.
- 2) The Unified Modeling Language User Guide, Grady Booch, James Rumbaugh and Ivar Jacobson, 2018, Addison-Wesley.
- 3) Software Engineering: A Practitioners Approach, Roger S Pressman, 2014, Mc Graw Hill.
- 4) Object-Oriented Software Engineering: Using UML, Patterns and Java, Bernd Bruegge and Allen H. Dutoit , 2003, Pearson Education.

APPLIED MACHINE LEARNING

(23CA52A10)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA52A10	APPLIED MACHINE LEARNING	AML	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	Demonstrate the types of machine learning and model representation.	2
CO2	Implementing Linear Regression model for supervised learning	3
CO3	Experimenting with Multiple Linear Regression model.	3
CO4	Estimating various Regression coefficient.	4
CO5	Integrate the concepts of supervised learning models in machine learning	4
CO6	Evaluate machine learning models and plot the decision boundary plots using python	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge	2	2	2	2		
PO2	Problem Analysis: Ability to identify computing problem and analyze the	3	3	3	3		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.					2	2
PO4	Research: Apply research-based knowledge and methodologies to					3	3

Syllabus:

Introduction to Machine Learning Algorithms: Introduction to Machine learning ,Statistical Learning ,types of Machine learning models: geometric, probabilistic and logistic models, introduction to supervised, unsupervised and reinforcement learning ,model evaluation ,model implementation ,model accuracy indicators. Supervised Learning ,Simple Linear Regression Analysis: Introduction to parametric machine learning method, assumptions of parametric machine learning methods, linear model and its assumptions, simple linear regression, scatter diagram, Simple linear Regression parameter estimation, properties of regression parameters, testing the significance of regression parameters

Supervised Learning ,Multiple Linear Regression Analysis I .Multiple linear regression model, assumptions of Multiple linear regression variables ,multicollinearity, homoscedasticity, autocorrelation, effects of multicollinearity, effect of homoscedasticity and auto autocorrelation in parameter estimation, Least -Squares Estimation of the Regression Coefficients, Geometrical Interpretation of Least Squares, Properties of the Least ,Squares Estimators, Inadequacy of Scatter Diagrams in Multiple Regression

Supervised Learning :Multiple Linear Regression Analysis I Multiple linear regression model, assumptions of Multiple linear regression variables , multicollinearity, homoscedasticity, autocorrelation, effects of multicollinearity, effect of homoscedasticity and auto autocorrelation in parameter estimation, Least Squares Estimation of the Regression Coefficients, Performance metrics in regression

Classification Problem with Python, Data Visualization, Statistical Summary, Create Training and Test Sets and Apply Scaling, Build Models, predicting new observations, residual analysis, model adequacy and validation. Supervised Learning: Logistic Regression, Decision Tree, K-Nearest Neighbors, Linear Discriminant Analysis, Gaussian Naive Bayes, Support Vector Machine, Decision Boundary plots

Reference Books:

- 1) Introduction to Linear Regression Analysis, DOUGLAS C. MONTGOMERY, ELIZABETH A. PECK, G. GEOFFREY VINING, 2021, A JOHN WILEY Et SONS, INC., PUBLICATION.
- 2) Introduction to Machine Learning , Ethem Alpaydm, 2014, MIT Press.
- 3) Python Machine Learning, Sebastian Raschka, 2017, PACKT Publishing.
- 4) Using Multivariate Statistics, Barbara G. Tabachnick, Linda S. Fidell, 2021, Pearson Education Inc.
- 5) Introduction to machine learning with Python, Andreas Muller, 2016, Shroff/O'Reilly

PATTERN RECOGNITION

23CA52A2O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA52A2O	PATTERN RECOGNITION	PR	R	3	0	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand basic concepts in pattern recognition	2
CO2	Understanding Generative Learning Models.	2
CO3	Understand Structured pattern recognition and Neural pattern recognition.	2
CO4	Apply pattern recognition techniques in practical problems.	3

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
P02	Problem Analysis: Ability to identify computing problem and analyze the	3	3	2	
P03	Design and Development: Design and develop efficient solutions for complex problems across different domains.		3		

Syllabus:

Introduction and general pattern recognition: Pattern Recognition (PR), Pattern Recognition Approaches, Examples of PR Applications, Pattern Recognition Extensions. Statistical pattern recognition: Introduction, Supervised, Parametric Approaches, Unsupervised Approaches

Bayes Classifier: Bayes Theorem, Minimum Error Rate Classifier, Estimation of Probabilities Comparison with the NNC, Naive Bayes Classifier. Hidden Markov Models: Markov Models for Classification, Hidden Markov Models, HMM Parameters, Learning HMMs, Classification Using HMMs

Classification of Test Patterns. Syntactic (structural) pattern recognition Et NN Classifiers: Introduction, Structural Analysis Using Constraint Satisfaction and Structural Matching, The Formal Language-based Approach, Learning/Training in the Language-based Approach. Nearest Neighbour Based Classifiers: Nearest Neighbour Algorithm, Variants of the NN Algorithm, Use of the Nearest Neighbor Algorithm for Transaction Databases, Minimal Distance Classifier (MDC).

Applications of Pattern Recognition: Fingerprinting, cursive characteristic recognition, Biometrics, Rice inspection, Food quality analysis,

Reference Books:

- 1) Introduction to Statistical Pattern Recognition, Fukunaga,, 2011, Academic Press.
- 2) Pattern Classification, Richard O. Duda, Peter E. Hart, David G. Stork,, 2011, Wiley.
- 3) Pattern Recognition and Machine Learning, Christopher M. Bishop,, 2009, Springer.
- 4) Pattern Recognition, Sergios Theodoridis, Konstantinos Koutroumbas,, 2010, Academic Press.

CLOUD COMPUTING

23CA52C10

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA52C10	CLOUD COMPUTING	CC	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	Ability to explain various concepts, architectures and deployment models relating to the cloud computing technologies	2
CO2	Know the fundamentals of cloud, cloud Architectures and types of services in cloud	2
CO3	Apply the concept of virtualization and how this has enabled the development of Cloud Computing	3
CO4	Design different sample applications using IaaS, PaaS and SaaS deployment Model	3
CO5	Develop application programs using different platforms and languages	5
CO6	Interpret and Learn the Concept of Advanced Cloud Technologies and Cloud Databases	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2				
PO2	Problem Analysis: Ability to identify computing problem and analyze the			3	3		
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized					3	2

Syllabus:

Introduction to Cloud Computing meaning of Cloud Computing variations of cloud computing from other models
Essential Characteristics Cloud computing Architectures Technological Influences. Cloud Computing
Architecture the three deployment models IaaS PaaS SaaS and Types of clouds CLOUD INFRASTRUCTURE
Architectural Design of Compute and Storage Clouds Layered Cloud Architecture Development Design Challenges
Inter Cloud Resource Management Resource Provisioning and Platform Deployment Global Exchange of Cloud
Resources.

Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service
(SaaS); Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud. Establishing and using
a private cloud: Network topology, HW-SW specification, installing open stack, configuring open stack availing
services through open stacks, establishing virtual networks.

Infrastructure as a Service (IaaS): Introduction to IaaS, IaaS definition, Introduction to virtualization,
Different approaches to virtualization, Hypervisors, Machine Image, and Virtual Machine (VM). Resource
Virtualization: Server, Storage, Network, Virtual Machine (resource) provisioning and manageability,
Storage as a service, Examples Applications: Amazon EC2, Google Drive, OneDrive, Dropbox. Developing
applications Using IaaS.

Platform as a Service Introduction to PaaS What is PaaS Service Oriented Architecture Cloud Platform and
Management Computation Storage Examples Google App Engine Microsoft Azure [SalesForce.com](https://www.salesforce.com) [Force.com](https://www.force.com)
platforms Developing applications using PaaS Software as a Service Introduction to SaaS Web services Web 2.0
Web OS and Case Study on SaaS Provisioning scheduling and requesting VM that is identified with desired
software packages Development of Application software using the system software installed on the Virtual
Machine Developing Applications that use SaaS

Reference Books:

- 1) Cloud Computing, Kris Jamsa, 2013, Wiley India Pvt Ltd.
- 2) Cloud Security: A comprehensive Guide to Secure Cloud Computing., Krutz, Ronald L.; Vines,
Russell Dean, 2010, Wiley India Pvt Ltd
- 3) Cloud Computing Bible, Barrie Sosinsky, 2011, Wiley India.
- 4) Cloud Computing Concepts, Technology, Security, and Architecture, Thomas Erl and Eric Barcelo
Monroy, 2023, Pearson Education.

CLOUD INFORMATION SECURITY

23CA52C2O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA52C2O	CLOUD INFORMATION SECURITY	CIS	R	3	0	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Explain Importance of Information Security in the Cloud Context	2
CO2	Identify various concepts of cloud security	2
CO3	Develop the cloud vulnerabilities and threats	3
CO4	Construct how cloud and Security works in a seamless model	3

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2		
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized	3	2		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.			2	2

PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate resultand interpret it into optimized			2	2
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing			2	2
PO6	Project Management: Demonstrate knowledge on project management principles, interpersonal skill and communicate in the team effectively			2	2

Syllabus:

Introduction to Virtualization & Cloud: Virtualization and Cloud computing concepts, Private cloud Vs Public cloud, IAAS, PAAS Et SAAS concepts, Virtualization security concerns, Hypervisor Security, Host/Platform Security, Security communications, Security between Guest instances, Security between Hosts and Guests

Cloud Controls Matrix &Top Cloud Threats: Introduction to Cloud Controls Matrix Et Top Cloud Threats, Cloud Controls Matrix, Trusted Cloud Initiative architecture and reference model, requirements of Security as a Service (SecaaS) model and Top Security threats to the cloud model

Cloud Security: Cloud Security vulnerabilities and mitigating controls, Cloud Trust Protocol, Cloud Controls Matrix. Complete Certificate of Cloud Security Knowledge (CCSK).

Cloud Trust Protocol &Transparency: Introduction to Cloud Trust Protocol Et Transparency, Cloud Trust Protocol and Transparency, Transparency as a Service, Concepts, Security, Privacy & Compliance aspects of cloud.

Reference Books:

- 1) Cloud Computing Bible, Barrie Sosinsky, 2011, Wiley.
- 2) Cloud Computing Explained, John Rhoton, 2011, Wiley.
- 3) Cloud Computing Security, Tim Mather, Subra Kumaraswamy, Shahed Latif, 2016, O'Reilly Media, Inc..
- 4) Cloud Security and Privacy, Tim Mather, 2022, O'Reilly

CYBER SECURITY AND ETHICAL HACKING

23CA52S10

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA52S10	CYBER SECURITY AND ETHICAL HACKING	CSEH	R	3	0	2	4	5

Course Outcomes:

CCM	CO Description	BTL
CO1	Understand Information Systems and Cyber Security	2
CO2	Understand measures for various types of security threats and electronic payment systems	2
CO3	Illustrate the security issues involved in developing secure information systems.	3
CO4	Apply different ethical hacking methods.	3
CO5	Evaluate Various Cryptographic Methods.	5
CO6	Evaluate Various Cyber Security Threats and Ethical Hacking Tools.	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	3					
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		3				

PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.		3	3	3		
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized			2	2	3	2
PO6	Project Management: Demonstrate knowledge on project management principles, interpersonal skill and communicate in the team effectively						3

Syllabus:

Introduction to information systems, Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software.

Digital Signature, public Key Cryptography. Developing Secure Information Systems, Application Development Security, Information Security Governance Et Risk Management.

Introduction to Ethical Hacking: Hacking Methodology, Process of Malicious Hacking, Foot printing and Scanning: Foot printing, Scanning. Enumeration: Enumeration. System Web and Network Hacking: SQL Injection, Hacking Wireless Networking, Viruses, Worms and Physical Security: Viruses and Worms, Physical Security.

Reference Books:

- 1) Analysing Computer Security, Charles P. Pfleeger, Shari Lawerance Pfleeger, 2011, Pearson Education India..
- 2) Cryptography and Information Security, V.K. Pachghare, 2004, PHI Learning Private Limited, Delhi.
- 3) Introduction to Information Security and Cyber Laws, Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen kumar Shukla, 2014, Willey Dreamtech Press.
- 4) Information Assurance for the Enterprise, Schou, Shoemaker, 2006, Tata McGraw Hill.
- 5) Hacking Exposed 7th Edition, Stuart McClure, Joel Scambray, George Kurtz, 2012, Tata McGraw Hill.

CYBER FORENSICS

23CA52S2O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA52S2O	CYBER FORENSICS	CF	R	3	0	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand Forensic and recovery methods	2
CO2	Apply digital evidence ,network Forensics and Mobile Device Forensics.	3
CO3	Apply web forensics and email forensics to real world problems	3
CO4	Analyze the security policies, standards and cyber laws	4

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2			
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized	2	2	2	
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.		2	3	2
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized			2	3

Syllabus:

Computer Forensics : Introduction to Computer Forensics, Forms of Cyber Crime, First Responder Procedure- Non-technical staff, Technical Staff, Forensics Expert and Computer Investigation procedure, Case Studies
Storage Devices Et Data Recover Methods : Data Acquisition, Data deletion and data recovery method and techniques, volatile data analysis, Case Studies

Forensics Techniques I : Windows forensic, Linux Forensics, Network forensics ,sources of network-based evidence, other basic technical fundamentals, Network forensic investigative strategies, technical aspects, statistical flow analysis, packet analysis, forensics of wireless networks, network intrusion detection analysis, event log aggregation and correlation analysis, switches, routers and firewalls, Case Studies, Mobile Forensics , data extraction Et analysis, Steganography, Password cracking, Case Studies.

Forensics Techniques II : Cross drive analysis, Live analysis, deleted files, stochastic forensics, Dictionary attack, Rainbow attack, Email Tacking ,Header option of SMTP, POP3, IMAP, examining browsers, Case Studies

Cyber Law : Corporate espionage, digital evidences handling procedure, Chain of custody, Main features of Indian IT Act 2008 (Amendment), Case Studies, Incident specific procedures.

Reference Books:

- 1) Computer Forensics: Computer Crime Scene Investigation, John Vacca, 2015, Laxmi Publications.
- 2) Digital Forensic: The Fascinating World of Digital Evidences, Nilakshi Jain, 2016, Wiley.
- 3) Hacking Exposed Computer Forensics, Aaron Philipp, David Cowen, 2009, McGraw Hill.
- 4) Mastering Mobile Forensics, SoufianeTahiri, 2016, Packt Publishing.
- 5) Computer Forensics: A Beginners Guide , David Cowen, 2013, McGraw Hill.

HADOOP AND BIGDATA

23CA52D2O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA52D2O	HADOOP AND BIGDATA	HAD	R	3	0	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand the basic concepts of Big Data Analytics.	2
CO2	Applying Hadoop tool to solve big data related problems	3
CO3	Analyze Hadoop fit falls and use the spark tool for big data Analytics	4
CO4	Examine Hadoop plus Spark frameworks for effective real-world disputes of Big Data Analytics.	4

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	3			
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		3	2	
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.		3		3
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized			3	
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing				3

Syllabus:

Understanding Big Data: Definition of Big Data, Types of Big Data, How Big Data is Generated, Different source of Big Data Generation, Rate at which Big Data is being generated, Different Vs, How a single person is contributing towards Big Data, Significance for Big Data, Reason for Big Data, Understanding RDBMS and why it is failing to store Big Data, Future of Big Data, Maintenance or storage of Big data, Big Data use cases for major IT Industries.

Introduction to Hadoop: What is Hadoop, Apache Community, History of Hadoop, How is Hadoop Important, Apache Hadoop Ecosystem, Hadoop Architecture, Difference between Hadoop 1.x, 2.x and 3.x Architecture, Master-Slave Architecture, Advantages of Hadoop. HDFS and its features, Map Reduce and its features, Map Reduce V1 vs Map Reduce V2, Hadoop YARN job scheduling in YARN, storage options in HADOOP: File Formats and Compression Formats, Encryption, and User Authentication.

Introduction to Spark: What is Spark, history of Spark, Theoretical concepts in Spark: Resilient distributed datasets, Directed acyclic graphs, Spark Context, Spark Data Frames, Actions and Transformations, Spark deployment options, Spark APIs. Core Components in Spark : Spark Core, Spark SQL, Spark Streaming, GraphX, MLlib. The Architecture of Spark.

Big Data Analytics with Hadoop plus Spark: Limitations of Hadoop, Overcoming limitations of Hadoop, Spark solutions, spark practical on big data analytics, Hadoop Practical on Big data analytics, Hadoop vs. Spark, Why Hadoop plus Spark : Hadoop features, Spark features. Installing Hadoop plus Spark Clusters.

Reference Books:

- 1) Practical Big Data Analytics , Nataraj Dasgupta , 2018, Packt Publishing .
- 2) Big Data Analytics , Venkat Ankam , 2016, Packt Publishing.
- 3) Big Data Analytics with Hadoop 3.0 , Sridhar Alla , 2018, Packt Publishing .
- 4) Hadoop: The Definitive Guide , Tom White , 2015, OREILLY .

SEM-3

WEB TECHNOLOGIES

23CA61080

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61080	WEB TECHNOLOGIES	WE	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	Illustrate the basic concepts of HTML and CSS & apply those concepts to design static web pages	2
CO2	Identify and understand various concepts related to dynamic web pages and validate them using JavaScript	2
CO3	Apply the concepts of Extensible markup language	3
CO4	Examine web Applications using Scripting Languages & Frameworks	4
CO5	Create and deploy secure, usable database driven web applications using PHP	5
CO6	Design Dynamic Web Pages by using HTML, CSS, JS, PHP	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2		2		

PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized			2			
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing					2	2

Syllabus:

Introduction to Web Technology: HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Html styles, Elements, Attributes, Heading, Layouts, Html media, I frames Images, Hypertext Links, Lists, Tables, Forms, GET and POST method, HTML 5 Dynamic HTML. CSS: Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms, The Box Model, Conflict Resolution, CSS3.

Introduction to JavaScript: Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions, Fundamentals of Angular JS and NODE JS Introduction to XML: Syntax of XML, Document Structure, Document type definition, Namespaces, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX.

Introduction to PHP: Overview of PHP, general server characteristics, Creating PHP Pages, Form handling, Data Base access with PHP & MySQL. Web Servers- IIS (XAMPP, LAMP) and Tomcat Servers.

Java Web Technologies, Introduction to Servlet, Life cycle of Servlet, Servlet methods, Java Server Pages. Database connectivity Servlets, JSP, Practice of SQL Queries. Web development frameworks , Introduction to Ruby, Ruby Scripting, Ruby on rails ,Design, Implementation and Maintenance aspects.

Reference Books:

- 1) Programming the World Wide Web , Robet W Sebesta , 7th Edition ,2020, Pearson .
- 2) Web Technologies , Uttam K Roy , 1st Edition ,2015, Oxford .
- 3) Web Hosting for Dummies , Peter Pollock , 1st Edition ,2014, John Wiley Sons.
- 4) RESTful web services , Leonard Richardson , 1st Edition ,2015, O'Reilly.

ESSENTIALS OF RESEARCH DESIGN

23IE52010

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23IE52010	ESSENTIALS OF RESEARCH DESIGN	ERD	R	1	1	0	0	2

Course Outcomes:

CO#	CO Description	BTL	PO Mapping
CO1	Illustrate Research objects, steps involved in research and articulate appropriate Research Questions	3	PO1
CO2	Perform Literature Review in a Scholarly style and apply appropriate methods for Data collection	3	PO2
CO3	Represent the data in tabular/Graphical form and prepare data for analysis	3	PO2
CO4	Perform statistical modelling and analysis to optimize the data, prepare the data for publishing.	4	PO2

Syllabus:

Module 1	Definition and objectives of Research-Types of research, Various Steps in Research process, Applied Mathematical tools for analysis, developing a research question- Choice of a problem, Literature review, Surveying, Synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.
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Module 2	Literature Review (LR)-Meaning and its Types-Narrative and Systematic, LR using Web of Science, Google and Google Scholar, Citations-Types, referencing in academic writing, Citation vs Referencing Vs Bibliography, Citation tools- Zotero, Qualitative Research and its methods, Quantitative Research, and its Methods. Data Collection-Primary data collection using Questionnaire, Google forms, survey monkey, Testing the validity and Reliability of Questionnaire using Factor Analysis and Cronbach's Alpha respectively, Secondary data- sources.
Module 3	Diagrammatic and graphical presentation of data: Diagrams and Graphs of frequency data of one variable- histogram, barcharts-simple, sub-divided and multiple; line charts, Diagrams and Graphs of frequency data of two variables -scatter plot, preparing data for analysis. Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Error Analysis.
Module 4	Analyzing data using one-dimensional statistics, two-dimensional statistics and multidimensional statistics. Technical Writing and Publishing, Conference presentations, Poster Presentations, Plagiarism-check and tools, Self-Plagiarism. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, Design Thinking for Contextualized Problem-Solving and Empathetic Research

Reference Books:

SI No	Title	Author(s)
1	Research Methods for Engineers	C.R. Kothari
2	Engineering Research Methodology	Y Krishnan Nallaperumal
3	Engineering Research Methodology -A Practical Insight for Researchers	Dipankar Deb and Balas

COMPUTER VISION

23CA61A3O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61A3O	COMPUTER VISION	CV	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand the need for image transformations and modeling, different types of image transformation, and their properties.	2
CO2	Apply the techniques and transformation methods for image enhancement and image restoration.	3
CO3	Solve image processing algorithms to perform feature detection, matching, segmentation and recognition.	3
CO4	Analyse NN, ML, and DL algorithms for image transformation, pose consistency, and segmentation.	4
CO5	Evaluating the study of image processing and machine learning algorithm for computer vision	5
CO6	Design and develop practical and innovative image processing and computer vision applications or systems and Conduct themselves professionally and responsibly in the areas of computer vision	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2	2	3		
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		2	3			
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized	2					
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing				3	3	3

Syllabus:

Introduction to computer vision: 2D and 3D transformations, Co-vectors, Stretch/squash, planar surface flow, Bi linear interpolation, 3D rotations, 3D to 2D projections, orthography and para perspective, Pin hole camera model, camera intrinsic, image sensing pipeline, sampling and aliasing

Linear filtering, 1D and 2D convolution, separable filtering, Examples of linear filtering, (Moving average/Box filters, Bi linear, Gaussian, Sobel, Corner filter) Bandpass and steerable filters, application of gaussian, Non linear filters, Median filter, Bilateral filter, Binary image processing, Morphology, Fourier transform, DCT, Applications sharpening, blur and noise removal, interpolation, decimation, multi resolution, image pyramids

Boundary detection, Fitting lines and curves, Active contours, Hough transform, Generalized hough transform, SIFT detector, Interest points, Detecting blobs, SIFT detector, SIFT descriptor, SURF features

Image stitching,Image transformations(2×2 & 3×3),Computing homography,Dealing with outliers,RANSAC,Face detection,Uses of face detection,Haar features for face detection,Integral image,Nearest neighbour classifier,Support vector machines,Perception,Object tracking,image segmentation,Appearance matching,Deep learning architecture for computer vision applications,Convolutional neural networks,Imagenet dataset,YOLO,VGG16/19,RESNET,EfficientNet,U- NET

Reference Books:

- 1) Perform basic image handling and processing operations on the image, Russel kirsch, 2011, Kickstarted publications.
- 2) Geometric transformation,compute homography matrix, Razavan, 2013, Klein.
- 3) Edge detection,Line detection and corner detection, Mohamed aei-sayad, 2012, Lambert.
- 4) Image classification using SVM, Ramon Amayan, 2010, Rupa publications.
- 5) Image classification using SVM, Mario Amando, 2019, Bloomsbury.

APPLIED DEEP LEARNING

23CA61A4O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61A4O	APPLIED DEEP LEARNING	ADL	R	3	0	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Describe the fundamental concepts of deep learning, including neural networks, activation functions, loss functions, and optimization techniques.	2
CO2	Construct deep learning frameworks with TensorFlow or PyTorch to develop and implement deep learning models.	3
CO3	Develop deep learning techniques to image classification, object detection, and natural language processing tasks	3
CO4	Organize Generative Adversarial Networks (GANs) for image and text generation.	3

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2		2	2
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized	3	2	2	3
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.		3		

PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized				
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing	2		2	2

Syllabus:

Introduction to Deep Learning: Overview of machine learning and deep learning Neural networks and their components Activation functions, loss functions, and optimization Training deep neural networks.

Convolutional Neural Networks (CNNs): Fundamentals of image data and preprocessing Building and training CNNs Applications of CNNs (e.g., image classification, object detection) Recurrent Neural Networks (RNNs): Sequence data and time series analysis Building and training RNNs Applications of RNNs (e.g., natural language processing, speech recognition).

Transfer Learning and Pretrained Models: Transfer learning techniques, Fine-tuning pretrained models, Reinforcement learning and its applications Explainable AI and model interpretability, Ethical considerations in deep learning. Natural Language Processing (NLP) and Transformers: Introduction to NLP Transformers architecture for NLP tasks Fine-tuning pre-trained language models.

Generative Adversarial Networks (GANs): Introduction to GANs Training GANs for image generation Applications of GANs (e.g., image synthesis) Deploying Deep Learning Models: Model deployment methods (e.g., cloud, edge devices) Model optimization and inference speed Model version control and updates

Reference Books:

- 1) Deep Learning With Python , Francois Chollet, 2021, Manning publishers.
- 2) Grokking Deep Learning, Andrew w Trask, 2019, Manning publishers.
- 3) Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, 2016, MIT Press Book.
- 4) Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, 2017, Oreilly publications.

APPLICATIONS OF NATURAL LANGUAGE PROCESSING

23CA61A50

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61A50	APPLICATIONS OF NATURAL LANGUAGE PROCESSING	ANLP	R	3	0	2	0	4

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand approaches to syntax and semantics in NLP	2
CO2	Apply the statistical estimation and statistical alignment models.	3
CO3	Apply grammar formalism and context free grammars	3
CO4	Apply Rule based Techniques, Statistical Machine translation (SMT), word alignment.	3
CO5	Evaluating NLP algorithms using python	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2			3	
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		3	3		
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing					3

Syllabus:

overview of NLP. Statistical machine translation. Language models and their role in speech processing. The problem of ambiguity. NLP tasks in syntax, semantics, and pragmatics. Words: Structure, Semantics, Parts of Speech, Sentences: Basic ideas in compositional semantics, Classical Parsing (Bottom up, top down, Dynamic Programming: CYK parser). Sentences: Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters. N-gram Language Models.

Information Theory: The role of language models. Simple N-gram models, Entropy, relative entropy, cross entropy. Statistical estimation and smoothing for language models. Part Of Speech Tagging and Sequence Labeling. Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). n-gram models. Syntactic parsing: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Top-down and bottom-up parsing, empty constituents, left recursion.

Modern Statistical Parsers Search methods in parsing: Agenda-based chart, A*, and "best-first" parsing. Dependency parsing. Discriminative parsing. Semantic Analysis: Lexical semantics and word-sense disambiguation. Discourse: Reference resolution and phenomena, syntactic and semantic constraints on Coreference, pronoun resolution algorithm, text coherence, discourse structure. Semantic Role Labeling and Semantic Parsing

Information Extraction (IE): Named entity recognition and relation extraction. IE using sequence labeling. Information sources, rule-based methods, evaluation (recall, precision). Statistical Machine Translation (SMT), Alignment Models. Statistical Alignment Models and Expectation Maximization (EM) EM and its use in statistical MT alignment models. The EM algorithm. Machine Translation (MT): Basic issues in MT. Rule based Techniques, Statistical Machine translation (SMT), word alignment, phrase-based translation, and synchronous grammars, case study: IBM models. Additional topics: Advanced Language Modelling (including LDA), other applications like summarization.

Reference Books:

- 1) **An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition**, Daniel Jurafsky and James H. Martin, , 2000, .pearson.
- 2) Natural language Understanding , James A , 1995, Pearson Education.
- 3) Natural language processing: a Paninian perspective , Bharati A., Sangal R., Chaitanya V, 2000 , Pearson Education.
- 4) Natural language processing and Information retrieval , Siddiqui T., Tiwary U. S. , 2008, .Springer.
- 5) Foundations of Statistical Natural Language Processing Cambridge , Christopher D; Hinrich Schuetze", 1999, MIT Press.

CLOUD ARCHITECTURES

23CA61C3O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61C3O	CLOUD ARCHITECTURES	CA	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	Classify the significance of cloud computing and its services.	2
CO2	Demonstrating cloud services and models.	2
CO3	Experiment with virtualization and its applications.	3
CO4	Apply cloud services using Web Services Cloud to utilize cloud resources.	3
CO5	Measure various cloud services using web services for building and deploying applications.	5
CO6	Interpret and Learn the Concept of Advanced Cloud Technologies and Cloud Databases	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2	2	2		
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized	2	2		2	2	2
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.			3	3		
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized					2	2

Syllabus:

Overview of Cloud Computing - Brief history and Evolution of Cloud Computing, Traditional vs. Cloud Computing, Importance of Cloud Computing, Benefits and Challenges of Cloud Computing.

Cloud Computing Architecture: Cloud computing stack Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services Service Models (XaaS) Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS) Deployment Models Public cloud, Private cloud, Hybrid cloud, Community

Infrastructure as a Service(IaaS): Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM) Platform as a Service(PaaS): Introduction to PaaS What is PaaS, Service Oriented Architecture (SOA) Cloud Platform and Management Computation Storage. Software as a Service (SaaS:) Introduction to SaaS, Web services, Web 2.0, Web OS

Overview of Multi-Cloud Management Systems - Explain concept of multi- cloud management, Challenges in managing heterogeneous clouds, benefits of multi-cloud management systems. Overview of Cloud Security - Security concerns in Traditional IT, Challenges in Cloud Computing in terms of Application, Server, and Network Security. Service Management in Cloud Computing: Service Level Agreements (SLAs).

Reference Books:

- 1) Cloud Computing: Principles and paradigms., Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski , 2013, Wiley.
- 2) Cloud Security, A comprehensive Guide to Secure Cloud Computing., Krutz, Ronald L.; Vines, Russell Dean, 2010, Wiley.
- 3) Cloud Computing Bible, , Barrie Sosinsky, 2011, Wiley.
- 4) Cloud Architecture Demystified, Keshri Asthana/ Ankur Mittal, 2023, BPB.

CLOUD AND SERVERLESS COMPUTING

23CA61C4O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61C4O	CLOUD AND SERVERLESS COMPUTING	CSC	R	3	0	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand the concepts of Cloud Serverless Computing	2
CO2	Organize the Serverless cloud Architecture	3
CO3	Experiment with the appropriate methodologies of testing and debugging serverless functions.	3
CO4	Implement knowledge representation using Event-driven Programming in Serverless Architectures	3

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2	2	2
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized	3	3	3	3
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing	2	2	2	2

Syllabus:

Introduction to Cloud Serverless Computing, Overview of serverless computing, Benefits and drawbacks of serverless architecture, Comparison with traditional server-based approaches, Serverless platforms and providers

Serverless Architecture, Serverless design patterns, Microservices and serverless, Scalability and elasticity in serverless environments, Data storage and management in serverless applications

Function-as-a-Service (FaaS), Introduction to FaaS platforms, Developing serverless functions, Managing dependencies and external integrations Testing and debugging serverless functions

Event-driven Programming in Serverless Architectures, Understanding event-driven programming models, Event sources and triggers, Implementing event-driven workflows, Orchestration and choreography

Reference Books:

- 1) Serverless Architectures on AWS: With examples using AWS Lambda, Peter Sbarski, 2017, DT Editorial Services.
- 2) Building Serverless Web Applications Paperback, Diego Zanon, 2017, Packt Publishing Limited.
- 3) Serverless Applications with Node.js Using AWS Lambda and Claudia.js, Slobodan Stojanovic,Aleksandar Simovic
- 4) Mastering AWS Lambda: Learn how to build and deploy serverless applications, Yohan Wadia and Udit Gupta , 2017, Packt Publishing Limited.

CLOUD WEB SERVICES

23CA61C50

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61C50	CLOUD WEB SERVICES	CWS	R	3	0	2	0	4

Course Outcomes:

CO#	CO Description	BTL
CO1	Summarize the model of Cloud Computing As A Service	2
CO2	Illustrate the Networking Basics required for cloud services	2
CO3	Demonstrate the Control of workflow in cloud services	3
CO4	Apply the method of fault tolerance in cloud	3
CO5	Experiment with the AWS Cloud	3

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2	2	2	2
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized	2	2			
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.	3	3	3	3	3
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing					3

Syllabus:

Cloud Web concepts: Search engine, Apache Hadoop, Grid Computing, Amazon Web Services, REST APIs, SOAP API, Query API, User Authentication, Connecting to the Cloud, Open SSH Keys, Tunnelling/ Port Forwarding, Image (glance), Object Storage (swift), ACL, Logging, Signed URI, Compute (nova), Cloud value proportion, Cloud economics, cloud architecture and design principles, AWS Cloud basic services

Networking & Storage: Overview, Key pairs, Network Types, LAN, Gateways and Router, IP Classes and Subnets, CIDR, Utilities, Instances Management, Image Management, direct connect, hybrid deployments, VPN, Security groups, Block Storage (cinder), Ubuntu in the Cloud, Installation, Utilities, File system, basic concepts of storage and databases, various storage services, storage solutions, database services.

Global Infrastructure and Security: Methods of deploying and operating cloud, global infrastructure, availability zone, benefits of CloudFront and Edge locations. AWS Corer services, resources for technology support, methods for provisioning services, Benefits of shared responsibility model, layers of security, Multi Factor Authentication, Identity Access Management Security levels, security policies, benefits of compliance, security services.

Monitoring & Pricing: Approaches for monitoring, benefits of Cloud watch, CloudTrail, Trust Advisor, Pricing and support model, free tire, benefits of organization and consolidated billing, Budgets, Explorer, AWS pricing calculator, various AWS support plans, AWS market place.

Reference Books:

- 1) Cloud Computing: Principles and Paradigms, RajkumarBuyya, James Broberg, Andrzej M. Goscinski 2011, Wiley.
- 2) OpenStack Essentials , Dan Radez, 2009, Wiley.
- 3) Cloud Computing: Concepts, Technology and Architecture, Erl, 2009, Pearson Education.
- 4) Resource Management in Utility and , Han Zhao,Xiaolin Li, 2013, Springer.

MALWARE ANALYSIS

23CA61S3O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61S3O	MALWARE ANALYSIS	ML	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	To understand the Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots, Creating fake networks	2
CO2	To Understand the concept of x.86 Architecture	2
CO3	To Apply the concept of in depth malware analysis by using different tools.	3
CO4	To Apply the concept of Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection, YARA rule based detection	3
CO5	Choose and analyze the malware using different tools.	5
CO6	Evaluate malware analysis programs web servers and password cracking	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2	2	2		
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		2	3			
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized	2					
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing				3	3	2

Syllabus:

Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots, Creating fake networks

X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation

Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, API calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching

Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC Injection, YARA rule based detection.

Reference Books:

- 1) Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software, Michael Sikorski and Andrew
- 2) The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory, Michael Hale
- 3) Malware Analyst's Cookbook and DVD: Tools and Techniques for Fighting Malicious Code, Michael Hale Ligh, Steven
- 4) Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation, Bruce Dang,
- 5) Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz, 2011, No Starch Press.

SECURITY GOVERNANCE AND MANAGEMENT

23CA61S4O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61S4O	SECURITY GOVERNANCE AND MANAGEMENT	SGM	R	3	0	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Introduction to E-Government and E-Governance; Models of E-Governance	2
CO2	Apply knowledge of security frameworks (COBIT, CMMI, ISO) and risk management principles to define strategic security metrics aligned with governance objectives and information security outcomes.	3
CO3	Apply knowledge, by analyzing current security & risk landscapes, to implement comprehensive security strategy, including identifying gaps, defining success metrics, and adapting to challenges.	3
CO4	Understand and apply Incident Management and Response Metrics to various organizations. .	3

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2			
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized	2			
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.	2	3	3	
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized				3

Syllabus:

Governance Overview,How Do We Do It? What Do We, Why Governance?: Benefits of Good Governance, A Management Problem, Legal and Regulatory Requirements: Security Governance and Regulation, Roles and Responsibilities: The Board of Directors ,Executive Management, Security Steering Committee, The CISO,CIA Model , User identity and Access Management: Authentication, Account Authorization, Validation, Access Control

Strategic Metrics: Governance Objectives, Information Security Outcomes: Defining Outcomes, Security Governance Objectives: Security Architecture, CobiT ,Capability Maturity Model , ISO/IEC 27001/27002 63, Other Approaches, Risk Management Objectives: Risk Management Responsibilities, Managing Risk Appropriately ,Determining Risk Management Objectives

Current State: Current State of Security, Current State of Risk Management , Gap Analysis,Unmitigated Risk , Developing a Security Strategy: Failures of Strategy ,Attributes of a Good Security Strategy Strategy Resources , Strategy Constraints, Sample Strategy Development: The Process, Implementing Strategy: Action Plan Intermediate Goals , Action Plan Metrics , Reengineering , Inadequate Performance , Elements of Strategy

Security Program Development Metrics: Information Security Program Development Metrics, Program Development Operational Metrics, Information Security Management Metrics: Management Metrics, Security Management Decision Support Metrics, CISO Decisions, Incident Management and Response Metrics: Incident Management Decision Support Metrics

Reference Books:

- 1) INFORMATION SECURITY Governance: A Practical Development and Implementation Approach, Krag Brotbya, 2023, Wiley.
- 2) Information Systems Security: Security Management, Metrics, Frameworks And Best Practices, Nina Godbole,
- 3) Principles of Information Security, Michael E. Whitman, 2014, Cengage Learning India Private Limited.
- 4) The Security Risk Management Body of Knowledge (CISSP Risk and Information Security Domain), James M. Conrad, 2024, Auerbach Publications.

CLOUD SECURITY

23CA61S50

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61S50	CLOUD SECURITY	CS	R	3	0	2	0	4

Course Outcomes:

CO#	CO Description	BTL
CO1	Explain the Importance of Information Security in the Cloud Context.	2
CO2	Identify various concepts of cloud security.	2
CO3	Develop the cloud vulnerabilities and threats	3
CO4	Construct how cloud and Security works in a seamless model	3
CO5	Practical : Evaluate the the Cloud Trust Protocol (CTP) and its role in fostering trust and transparency in cloud deployments	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2	2			2
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized	3	2	2	2	2
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.			3	3	
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized					2
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing			3	2	2
PO6	Project Management: Demonstrate knowledge on project management principles, interpersonal skill and communicate in the team effectively			2	2	

Syllabus:

Introduction to Virtualization & Cloud: Virtualization and Cloud computing concepts, Private cloud Vs Public cloud, IAAS, PAAS & SAAS concepts, Virtualization security concerns, Hypervisor Security, Host/Platform Security, Security communications, Security between Guest instances, Security between Hosts and Guests

Cloud Controls Matrix & Top Cloud Threats: Introduction to Cloud Controls Matrix & Top Cloud Threats, Cloud Controls Matrix, Trusted Cloud Initiative architecture and reference model, requirements of Security as a Service (SecaaS) model and Top Security threats to the cloud model

Cloud Security: Cloud Security vulnerabilities and mitigating controls, Cloud Trust Protocol, Cloud Controls Matrix. Complete Certificate of Cloud Security Knowledge (CCSK).

Cloud Trust Protocol & Transparency: Introduction to Cloud Trust Protocol & Transparency, Cloud Trust Protocol and Transparency, Transparency as a Service, Concepts, Security, Privacy & Compliance aspects of cloud.

Reference Books:

- 1) Visible Ops Private Cloud Andi Mann, Kurt Milne and Jeanne Morain IT Process Institute, John Rhoton 2009, 2011, Visible Ops Private Cloud.
- 2) Cloud Computing Bible, Barrie Sosinsky, 2011, Wiley.
- 3) Cloud Computing Explained, John Rhoton, 2011, Openlibrary.
- 4) Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, and Shahed Latif, 2009, Shroff/O'Reilly.
- 5) Cloud Security A comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz and Russel Dean Vines, 2010, Wiley.

DATA VISUALIZATION TECHNIQUES

23CA61D30

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61D30	DATA VISUALIZATION TECHNIQUES	DVT	R	3	0	2	4	5

Course Outcomes:

CO#	CO Description	BTL
CO1	Understand the fundamental principles and techniques of data visualization and historical development and significance of data visualization	2
CO2	construct basic bar graphs, group bars, and represent counts using bar graphs and customizing bar graphs by adjusting colors, sizes, titles, axis units, bar widths, and spacing, as well as adding labels.	3
CO3	Understanding of multivariate graphical techniques and their applications and analyze the basics of network graphs and heat maps, and explain the differences between heat maps and tree maps	4
CO4	Focus on the fundamentals of graphical validation techniques used in multivariate statistical analysis visual representations, including dendrograms, scree plots, QQ plots, and PP plots.	4
CO5	Hands-on practice creating basic bar graphs, grouping bars ,customizing colour ,size, and title, adding labels ,and applying bar graphs in business scenarios.	5
CO6	Develop to Learn how to add text, mathematical expressions, lines, arrows, shaded shapes, error bars, and more. modifications axes are altering scaling ratios, and positioning tick marks, labels, circular graphs, use themes, and work with legends.	5

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2				2	2
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		3	2		2	
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.			3			2
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized		2	2	2		
PO5	Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources and modern IT tools to solve complex computing				3	2	3

Syllabus:

Introduction to Data Visualization: Brief history of data visualization, scientific design choices in data visualization- choice of graphical form, grammar of graphical techniques of large amount of data, crucial need of visualization techniques, challenges in visualization techniques, classification of visualization techniques for qualitative and quantitative data, power of visualization techniques.

Static Graphical Techniques 1: Introduction to bar graph, basic understanding of making basic bar graph, grouping bars together, bar graphs on counts, customization of bar graphs by changing colour, size, title, axis units, changing width and spacing of the bar chart, adding labels to bar graph, application of bar graph in business

Multivariate Graphical Techniques: Introduction to correlation matrix, application of correlation matrix in the multivariate analysis, network graph, basics of heat map, difference between heat map and tree map, introduction to higher dimensional scatter plot, axis adjustment in the higher dimensional scatter plot.

Graphical Validation : Basics of multivariate statistical visual representations and its results, dendrogram, importance of dendrogram in grouping (cluster analysis), Scree Plot, importance of Scree Plot, application of Scree Plot in determining number of clusters and factors, QQ plot, importance of QQ plot in distribution of data for the further quantitative analysis, PP plot, applications and usage of PP Plot for distribution detection. Customization : Introduction to annotations adding : text, mathematical expression , lines, arrows, shaded shapes, highlighting the texts and items, adding error bars, introduction to axis, swapping x and y axis, changing the scaling ration in the axis, positioning of axis and arranging tick marks and labels, changing the appearance of axis labels, circular graphs, using themes, changing the appearance of theme elements, creating the own themes, legends : removing the legends, position of legends, legend title, labels in legends.

Reference Books:

- 1) The Visual Display of Quantitative, Edward Tufte, 2001, Graphics Press.
- 2) Data Points - Visualization That Means Something, Nathan Yau, 2013, John Wiley & Sons Inc
- 3) Learning Responsive Data Visualization: Create stunning data visualizations that look awesome on every device and screen resolutions , Erik Hanchett , Christoph Kornor, 2016, packt.
- 4) Visualization Analysis and Design, Munzner , 2014 , A K Peters/CRC Pres.
- 5) Information Visualization: Perception for Design, Colin Ware , 2019 , Morgan Kaufmann .

STATISTICS FOR DATA SCIENCE

23CA61D40

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61D40	STATISTICS FOR DATA SCIENCE	SDS	R	3	0	0	0	3

Course Outcomes:

CO#	CO Description	BTL
CO1	Explain the significance of statistics in real life, basic concepts of statistics, data collection methods, and various techniques of descriptive statistics.	2
CO2	Demonstrate the probability distribution of a random variable based on real-world situation, and use it to compute expectation and variance.	2
CO3	Apply methods of correlation, and construct the linear and non-linear regression lines for the given data.	3
CO4	Build the skills and knowledge needed to efficiently manage, analyze, and interpret statistical data using Microsoft Excel.	3

Program Outcomes & Program Specific Outcomes:

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for	2		2	
PO2	Problem Analysis: Ability to identify computing problem and analyze the component of problem using principles of mathematics, specialized		2	3	3
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains.	3	3	3	
PO4	Research: Apply research-based knowledge and methodologies to analyze, design, validate result and interpret it into optimized				3

Syllabus:

Basic Statistics: Importance of Statistics-Primary and secondary data-Data collection methods Presentation of numerical and categorical data. Concepts of central tendency and dispersion-Mean, median and mode-Partition Values-Quartiles for grouped and ungrouped data-Range-Quartile Deviation-Standard deviation and coefficient of variation for grouped and ungrouped data.

Probability Distribution: Random Variable- Discrete Random and Continuous Random variable, Probability Distribution of a Random Variable, Mathematical Expectation Types: Binomial, Poisson, Normal Distribution, Mean and Variance of Binomial, Poisson, and Normal Distribution

Correlation Introduction Types Properties Methods of Correlation Karl Pearsons Coefficient of Correlation concept of point biserial correlation Rank Correlation and Phi coefficient Regression Introduction Aim of Regression Analysis Types of Regression Analysis Lines of Regression Properties of Regression Coefficient and Regression Lines Comparison with Correlation

Working on Statistical data with MS Excel Working with Data using MS Excel Importing Data Sort Data Filter Advance Filter Data Validation Data Consolidation What If Analysis Data Grouping Subtotal Data regression Working with function statistical functions Index numbers LPFs price and quantity index numbers Time reversal and factor reversal tests.

Reference Books:

- 1) Probability and Statistics for Engineers and Scientists, Ronald E. Walpole, Sharon L. Myers and , 4th, Pearson-8ed.
- 2) Fundamentals of Business Statistics, Sharma J.k., 3rd, Vikas Publishing House.
- 3) A textbook of probability and statistics, B. Sooryanarayana , 2nd, S. Chand 2003.
- 4) The Elements of Statistical Learning , Trevor Hastie, 2nd, Springer.

GRAPH AND WEB ANALYTICS

23CA61D5O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23CA61D5O	GRAPH AND WEB ANALYTICS	GWA	R	3	0	2	0	4

Course Outcomes:

CO#	CO Description	BTL	PO Mapping
CO1	Understand the importance of Bigdata on Graphs, Network basics and Social networks	2	PO1
CO2	Make use of Web Analytics – Data sources, tools, Web traffic data	3	PO1,PO5
CO3	Analyzing Web Analytics Strategy- website traffic analysis, audience identification and segmentation analysis, Emerging Analytics	4	PO1
CO4	Compare Email Testing Analysis, competitive Intelligence Analysis, and Social, Mobile, Video Analysis	4	PO1,PSO2
CO5	Implementing Python programming for graph and web analytics	4	PO4,PO5,PO6

Syllabus:

Module 1	Graph Analytics: Origin of Graph Theory, Graph Basics, types of Graphs, Finding the best path, Dijkstra's Algorithm, operation on graphs. Network Basics: Types of Networks, Properties of Networks, Network Measures, Matrices: Adjacency matrix SocialNetworks:Propertiesofsocialnetwork,scaleFreeNetwork,SmallworldNetworks,NetworkNavigation.Node_LevelAnalysis:Degree_centrality,closenesscentrality,betweennesscentrality,EigenvectorCentrality,pagerank,GroupLevelAnalysis:Cohesive subgroups,cliques,clusteringcoefficient,trialSlice,K-Cores.CommunityDetection:Graph partitioning, Hierarchical clustering
Module 2	Web Analytics: Introduction- State of the analytics union, state of the industry, Rethinking web analytics, clickstream, multiple outcomes analysis, experimentation a imperative, tactical shift. Strategy for choosing the optimal analytics tool- vendor selection analysis, running an effective tool pilot, checking SLA's for web-analytics vendor contract. Clickstream analysis- Critical web metrics,

	visits and visitors engagement, attributes of great metrics, strategically aligned tactics for impactful web metrics.
Module 3	Web Traffic Data: Practical solutions- Sources of traffic, outcomes, foundational analytical strategies, segmentation, benefits of and creating and app measuring the search quality, search engine optimization analysis, google example, content coverage, indexing by search engines, paid search analysis, direct traffic analysis, email campaign analysis, campaign response, website behaviour, data Testing, actionable testing ideas.
Module 4	Component of Web Analytics Strategy : Competitive Intelligence Analysis- Data Sources, website traffic analysis, search and keyword analysis, audience identification and segmentation analysis. Emerging Analysis of the performance of Videos.

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Python for graph and Network Analysis	Mohammad Zuhair Al-Taie, Seifedine Kadry	Springer Publication	2017
2	Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity	Avinash Kaushik	Sybex	2009
3	Graph Analysis and Visualization	Richard Brath David Jonker	Wiley publisher	2015
4	Advanced Web Metrics with Google Analytics	Brian Clifton	Syrex	2012
5	A textbook of Graph theory	R.Balakrishnan and K.Ranganathan	Universitext	2012

SEM-4

IPR AND PATENT LAWS

OEIN0001O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
OEBT0001O	IPR AND PATENT LAWS	IPR	R	3	0	0	0	3

Course Outcomes:

CO#	CODescription	PO/PSO	BTL
CO1	Understand the knowledge of intellectual property rights	PO1,PO8	3
CO2	Describe the principles and regulatory affairs	PO5	3
CO3	Develop documentation ,Protocols and Case Studies on Patents	PO7	3
CO4	Compare various Case Studies on Patents	PO9	3

Syllabus:

Intellectual Property Rights Patents and intellectual property rights (IPR): Definition, History of intellectual property; Types of intellectual property rights, copy rights, trade marks, geographical indication, Industrial design rights, patents. Sources of patent information, patent application procedures. Principles, Scope and Functions Of GATT&WTO GATTHistorical perspective, objectives and fundamental principles, impact on developing countries. WTO- Objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization, India-tasks and challenges. Regulatory Affairs Indian contest-requirements and guidelines of GMP, understanding of Drugs and cosmetic act 1940 and rules 1945 with reference schedule M,U & Y. Related quality systems-objectives and guidelines of USFDA,WHO & ICH; Introduction to ISO series. Documentation and Protocols Documentation: Types related to pharmaceuticals

industry, protocols, harmonizing formulation development for global fillings, NDA, ANDA, CTD, Dealing with post approval changes-SUPAC, handling and maintenance including electronic documentation. Case Studies on Patents. Case Studies on - Patents (Basmati rice, turmeric, Neem, and related medicinal plants and byproducts)

Text Books :

- 1) S. H. Willig, Good manufacturing practices for Pharmaceuticals, Informa Healthcare (Oct 2000).

Reference Books :

- 1) Industrial Property Rights: Vol. III-4, Kogan Pate, Kogan Pate, Kogan Page (May 1998)

Web Links : <https://ipindia.gov.in/>

FUNDAMENTALS OF IOT

OEIN0001O

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
OEIN0001O	FUNDAMENTALS OF IOT	FIOT	R	3	0	0	0	3

Course Outcomes:

CO#	CODescription	PO/PSO	BTL
CO1	Understand functional blocks of IoT devices	PO7,PSO1	2
CO2	Demonstrate the Technologies involved in IoT based Systems	PO7,PSO1	2
CO3	Apply different wireless technologies used for the development of IoT based Networks	PO1,PO7,PSO1	3
CO4	Analyze various IOT Real time application design Components	PO2,PO7,PSO1	4

Syllabus:

Module 1: Introduction to IoT and Building blocks: Introduction to IoT: Characteristics of IoT, IoT Ecosystem: Enabling Technologies in IoT, Applications of IoT, IoT Reference Model, Physical Design of IoT, Logical Design of IoT, IoT Communication API.

Module 2: IoT Network Architecture and Design: Major components of IoT System, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management, and Compute Stack, IoT Levels & Deployment Templates.

Module 3: Engineering IoT Networks: Smart Objects: The “Things” in IoT: Definition, Characteristics, Trends, Sensor Networks: Merits and Demerits, IoT Access technologies, Communication Criteria, Wireless Sensing Technologies: RFID, Bluetooth, ZigBee, Wi-Fi, LoRa.

Module 4: IoT in Industry: Manufacturing: Industrial Automation and Control Systems Reference Model, Converged Plant wide Ethernet (CPwE) Reference Model, Automation Control Protocols: Ether Net/IP,

PROFINET, and Modbus/TCP, Edge Computing in the Connected Factory, Public Safety: An IoT Blueprint for Public Safety, Emergency Response IoT Architecture, IoT for School Bus Safety.

Text Books :1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry - IoT Fundamentals_ Networking Technologies, Protocols, and Use Cases for the Internet of Things-Cisco Press(2017), ISBN-13: 978-1-58714-456-1 2. Srinivasa K. G, Siddesh G. M and Hanumantha Raju R, Internet of Things, Cengage Learning India Pvt Ltd., 2019, ISBN: 978-93-86858-95-5 3. Arshdeep Bahga and Vijay Madisetti, Internet of Things - A Hands-on Approach, Universities Press, 2015, ISBN: 9788173719547

Reference Books:

- 1) Keyur K Patel, Sunil M Patel, Internet of Things-IoT: Definition, Characteristics, Architecture, Enabling Technologies, Application & Future Challenges.
- 2) WIRELESS COMMUNICATIONS AND NETWORKS, Second EDITION William Stallings Internet of Things A to Z: Technologies and Applications edited by Qusay F. Hassan

Web Links : https://onlinecourses.nptel.ac.in/noc22_cs53/preview

<https://www.youtube.com/watch?v=hdZzNOQV5vU>

MOOCS : <https://www.coursera.org/learn/introduction-iot-boards>

