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DEEMED TO BE
UNIVERSITY
— **ONLINE** —
NAVI MUMBAI

Curriculum for

Master of Computer Applications



Program Structure for
Master of Computer Applications

D. Y. Patil Deemed to be University, Navi Mumbai

List of Courses offered for MCA Programs with 6 specialisations

- General
- Cloud Computing
- Full Stack Development
- Data Analytics
- AI & ML
- Cyber Security

Semester	Course Type	Subject Name	New Credits	Total
Semester 1	Program Core Course (PCC)	Computational Statistics	4	22
Semester 1	Program Core Course (PCC)	Java for Full Stack Development	4	
Semester 1	Program Core Course (PCC)	Database Technology	4	
Semester 1	Research Methodology	Research Methodology	4	
Semester 1	Vocational Skill Enhancement	Web Technologies	2	
Semester 1	Vocational Skill Enhancement	Python Programming	4	
Semester 2	Program Core Course (PCC)	Analysis of Algorithms	4	24
Semester 2	Program Core Course (PCC)	Artificial Intelligence and Machine Learning	4	
Semester 2	Program Core Course (PCC)	Project Management	4	
Semester 2	Open Elective I	Natural Language Processing	4	
Semester 2	Open Elective II	Enterprise Resource Planning	4	



Semester 2	Program Core Course (PCC)	Big Data Analytics	4	
Semester 3	Elective: General	Applied Data Analytics with Python	4	20
Semester 3		DevOps Foundations: Version Control & CI/CD Tools	4	
Semester 3		Foundations of Cybersecurity	4	
Semester 3		Foundations of Cloud Computing	4	
Semester 3		Machine Learning Applications using Python	4	
Semester 4		Modern Web Services with REST API, ReactJS & NodeJS	4	22
Semester 4		Cloud Security and Risk Management	4	
Semester 4		Principles and Practices of Software Testing	4	
Semester 4		Technical Writing and Communication for IT Professionals	2	
Semester 4		Capstone Project	8	
Semester 3	Elective: Cloud Computing	Foundations of Cloud Computing	4	20
Semester 3		Essentials of Amazon Web Services (AWS)	4	
Semester 3		Microsoft Azure: Core Concepts and Services	4	
Semester 3		Programming for the Cloud Environment	4	
Semester 3		Virtualization Techniques in Cloud Computing	4	
Semester 4		Google Cloud Platform: Fundamentals	4	22
Semester 4		IBM Cloud: Service Overview and Applications	4	
Semester 4		Principles and Practices of Software Testing	4	
Semester 4		Technical Writing and Communication for IT Professionals	2	
Semester 4		Capstone Project	8	
Semester 3	Elective: Full Stack Development	Frontend Web Development HTML, CSS & JavaScript	4	20
Semester 3		Designing User Interfaces and Experiences (UI/UX)	4	



Semester 3		DevOps Foundations: Version Control & CI/CD Tools	4	
Semester 3		Principles of Software Architecture	4	
Semester 3		Rapid Prototyping for Web Applications	4	
Semester 4		Modern Web Services with REST API, ReactJS & NodeJS	4	
Semester 4		Advanced DevOps: Automation and Monitoring Tools	4	
Semester 4		Principles and Practices of Software Testing	4	22
Semester 4		Technical Writing and Communication for IT Professionals	2	
Semester 4		Capstone Project	8	
Semester 3		Applied Data Analytics with Python	4	
Semester 3		Data Analytics with SQL	4	
Semester 3		Techniques and Tools for Web Analytics	4	20
Semester 3		Analytics for Digital and social media	4	
Semester 3		Integrating IoT with Data Analytics	4	
Semester 4	Elective: Data Analytics	Statistical Data Analysis using R	4	
Semester 4		Data-Driven Decision Making	4	
Semester 4		Principles and Practices of Software Testing	4	22
Semester 4		Technical Writing and Communication for IT Professionals	2	
Semester 4		Capstone Project	8	
Semester 3		Machine Learning Applications using Python	4	
Semester 3		Statistical Foundations for Machine Learning with Python	4	
Semester 3	Elective: Artificial Intelligence and Machine Learning	Machine Learning for Business Intelligence	4	20
Semester 3		Deep Learning and Natural Language Processing (NLP)	4	
Semester 3		Web and Social Media Analytics with Data Visualization	4	
Semester 4		Big Data Processing with Hadoop Ecosystem	4	22



Semester 4		IoT, Cloud Computing, and Watson Analytics	4	
Semester 4		Principles and Practices of Software Testing	4	
Semester 4		Technical Writing and Communication for IT Professionals	2	
Semester 4		Capstone Project	8	
Semester 3	Elective: Cyber Security	Foundations of Cybersecurity	4	20
Semester 3		Network Security and Protocols	4	
Semester 3		Cryptography and Secure Communication	4	
Semester 3		Ethical Hacking and Penetration Testing	4	
Semester 3		Cyber Laws and Digital Forensics	4	
Semester 4		Cloud Security and Risk Management	4	22
Semester 4		Security Operations and Incident Response	4	
Semester 4		Principles and Practices of Software Testing	4	
Semester 4		Technical Writing and Communication for IT Professionals	2	
Semester 4		Capstone Project	8	
				88

* Common core courses will be offered to all students during Semesters 1 and 2.

* Students are required to choose any one elective bucket at the beginning of Semester 3 and continue with the same specialization in Semester 4.



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Semester - I Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S1-1	Computational Statistics	04	-	-	4	04

Prerequisites: Basic knowledge of Probability and Statistics.

Course Objectives:

1. To introduce students to the concepts of Multivariate Normal Distribution.
2. To become familiar with Discriminant analysis.
3. To become familiar with Dimensionality reduction Techniques.
4. To become familiar with Cluster Analysis Techniques

Course Outcome: Learner will be able to

1. CO 1: Understand the multivariate normal distribution.
2. CO 2: Determine whether linear discriminant analysis should be applied to a given data set.
3. CO 3: Understand how to do principal component analysis for given data set.
4. CO4: Understand how to apply maximum likelihood methods for estimating the parameters of a factor model.
5. CO 5: Understand problems of statistical inference and testing of hypothesis.
6. CO 6: Understand the concept of correlation to the engineering problems in Data Science, Machine Learning, and AI.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Multivariate Normal Distribution and Linear Regression. Multivariate Normal Distribution and its properties, Sampling from a multivariate normal distribution and maximum Likelihood Estimation, Random sampling from multivariate normal distributions. Introduction to multivariate linear regression, Least Square Estimation and inferences about the regression model.	07	CO1
2	Module 2: Multivariate Multiple Regression Model Multiple regression. Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions. Assumptions of Multivariate Regression Models, Parameter estimation, Multivariate Analysis of variance and covariance.	08	CO2
3	Module 3: Discriminant and Principal Component Analysis Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties. Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot.	08	CO3
4	Module 4: Factor Analysis Factor analysis model, extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.	08	CO4
5	Module 5: Tests of significance Null and Alternative hypotheses, type I and type II errors, Testing of hypothesis, parametric test: z-test, t-test and F-test, Non parametric test: chi square test, Sign Test and Median Test, Analysis of Variance (ANOVA)	07	CO5



6	Module 6: Correlation Analysis Definition, meaning and concept of correlation meanings and correlation-Scatter diagram and its uses for correlation analysis; Covariance between two variables: Definition, meaning, computations and effect of change of origin and scale; Karl Pearson's coefficient of Correlation (ρ or r): Computations for grouped and ungrouped data. Interpretation of results and Properties.	07	CO6
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Text Books:

1. George F Luger, Artificial Intelligence, Fifth Edition-2009, Pearson Education Publications ,ISBN- 978-81-317-2327-2
2. Stuart Russell, Peter Norvig ,Artificial Intelligence – A Modern Approach, , Pearson Education / Prentice Hall of India, 3rd Edition, 2009 .ISBN- 13: 978- 0136042594
3. Agarwal, B.L. (2006):-Basic Statistics. Wiley Eastern Ltd., New Delhi.
4. Applied Multivariate Statistical Analysis, Johnson and Wichern, sixth edition, Pearson

Reference Books:

1. Gupta, S. P. (2011):-Statistical Methods. Sultanchand & Sons, New Delhi
2. Sivathanupillai, M &Rajagopal, K. R. (1979):-Statistics for Economics Students.
3. Beginning R: The Statistical Programming Language, Mark Gardener, Wiley



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S1-2	Java for Full Stack Development	04	-	-	04	04

Prerequisites:

1. Basic understanding of any Object-Oriented Programming Language
2. Successfully completed Programming Concepts of Core Java course

Course Objectives:

1. Learn the basic data structure operation using Java Collection Framework and understand Lambda expressions.
2. Build web applications using JSP and JSTL.
3. Understand Spring Framework and build Java EE applications and services.
4. Apply Data Access using Spring Framework
5. Understand how to simplify Spring applications using Spring Boot and spring Boot RESTful WebServices.

Course Outcome: Learner will be able to

1. CO1: Demonstrate use of data structure and data manipulation concept using Java Collection Framework and Lambda expressions.
2. CO 2: Create JSP using standard actions, custom tags, Introduction to JSP Standard Tag Library (JSTL) and JSTL Tags.
3. CO 3: Understand and develop applications using Spring Framework, Lightweight Container and Dependency Injection with Spring
4. CO 4: Develop applications using Aspect Oriented Programming with Spring.
5. CO 5: Apply JDBC Data Access with Spring and demonstrate Data access operations with Jdbc Template and Spring.
6. CO 6: Create Spring Boot Web Application and Spring Boot RESTful WebServices.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1: Collection and Generic : Introduction to Generics , Generics Types and Parameterized Types, WildCards, Java Collection Framework, Collections (Basic Operations, Bulk Operations, Iteration) List, Set, Maps Lambda Expressions - Lambda Type Inference, Lambda Parameters, Lambda Function Body, Returning a Value,From a Lambda Expression, Lambdas as Objects. Self learning topics Collection Queues and Arrays	06	CO1
2	Module2: Introduction Java EE Programming JSP Architecture, JSP building blocks, Scripting Tags,implicit object,Introduction to Bean,standardactions,session tracking types and methods. Custom Tags, Introduction to JSP Standard Tag Library (JSTL) and JSTL Tags. Self learning topics Simple Application using Servlet	09	CO2
3	Module3: Spring Frameworks: Introduction to Spring Framework, POJO Programming Model, Lightweight Containers(Spring IOC container, Configuration MetaData, Configuring and using the Container) Dependency Injection with Spring- Setter Injection, Constructor Injection, Circular Dependency, Overriding Bean, Auto Wiring Bean Lookup, Spring Manage Beans) Self learning topics Bean Definition Profiles	09	CO3
4	Module4 : Spring and AOP AspectOriented Programming with Spring, Types of advices, Defining Point Cut Designator,Annotations. Self learning topics AspectJ	07	CO4
5	Module5: JDBC Data Access with Spring Managing JDBC Connection, Configuring Data Source to obtain JDBC Connection, Data Access operations with JdbcTemplate and Spring, RDBMS operation classes , Modelling JDBC Operations as Java Objects	07	CO5



	Self learning topics JDBC Architecture and basic JDBC Program using DML operation		
6	Module6: Getting Started with Spring Boot Spring Boot and Database, Spring Boot Web Application Development, Spring Boot RESTful WebServices. Self learning topics Understanding Transaction Management in Spring	07	CO6

Text Books:

1. a 6 Programming Black Book, Wiley–Dreamtech ISBN 10: 817722736X ISBN 13: 9788177227369
2. Web Enabled Commercial Application Development using java 2.0, Ivan Byaross ISBN-10: 8176563560 / ISBN-13: 978-8176563567
3. Java Server Programming java EE6, Black book, Dreamtechpress. ISBN-10: 8177229362 / ISBN-13: 978-8177229363
4. Core Servlets and Java Server Pages :Vol I: Core Technologies 2/e , Marty Hall and Larry Brown, Pearson , ISBN: 9788131701638, 8131701638
5. Java Enterprise in a Nutshell, 3rd Edition A Practical Guide, Jim Farley, William Crawford,O'Reilly ISBN-13: 978-0596101428 / ISBN-10: 0596101422

Reference Books:

1. Java EE 6 Server Programming For Professionals, Sharanam Shah and Vaishali Shah, SPD, ISBN-10: 9788184049411 / ISBN-13: 978-8184049411
2. Spring in Action, Craig Walls, 3rd Edition, Manning, ISBN 9781935182351
3. Professional Java Development with the Spring Framework by Rod Johnson et al. John Wiley & Sons 2005 (672 pages) ISBN:0764574833
4. Beginning Spring , Mert Caliskan and KenanSevindik Published by John Wiley & Sons, Inc. 10475 Crosspoint Boulevard Indianapolis, IN 46256 www.wiley.com

Web References:

1. <https://docs.oracle.com>
2. Spring.io



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S1-3	Database Technology	04	-	-	04	04

Prerequisites: Data Structures, Basic Mathematics

Course Objectives:

1. Learn and practice data modelling using the entity-relationship and developing database designs.
2. Understand the use of Structured Query Language (SQL) for accessing database.
3. To provide insights into distributed and parallel database designing.
4. To learn advanced representations of databases suited for real-time applications.

Course Outcome: Learner will be able to

1. CO 1: Understand the fundamentals of database systems and design ER for the real-life problem.
2. CO 2: Convert conceptual model to relational model, formulate relational algebra queries.
3. CO 3: Analyze and apply concept of normalization to relational database design.
4. CO 4: Design and querying database using SQL.
5. CO 5: Design advanced databases like parallel, distributed and object relational databases.
6. CO 6: Compare different types of NoSQL databases.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to database systems: Data models, architecture of a database, Challenges in building a DBMS. Entity Relationship Model, Extended Entity Relationship Model: Specialization, Generalization and Aggregation.	06	CO1
2	Relational Data Model: Introduction to the Relational Model and concept of keys, Mapping the ER to the Relational Model. Relational Algebra: Relational Algebra Operations and Relational algebra queries.	08	CO2
3	Relational Database Design: Importance of a good schema design, functional dependencies. 1NF, 2NF, 3NF, BCNF, 4NF, 5NF.	07	CO3
4	Overview of SQL: SQL statements (commands) – DDL, DML, DTL and DCL. Integrity Constrains, set and string operations, aggregate function, views, Joins, Nested and Complex queries	07	CO4
5	Parallel Database, Distributed Database and ORDBMS: Architecture for Parallel Databases, Types of Distributed Databases, Distributed DBMS Architecture, Storing Data in a Distributed DBMS, ORDBMS- Structured Data Types, Operations on Structured Data, Objects, OIDs and Reference Types, Object oriented versus Object relational database.	09	CO5
6	Introduction to NoSQL Databases: NoSQL database concepts: NoSQL data modeling, Benefits of NoSQL, comparison between SQL and NoSQL database system. Types of NoSQL databases: Key-value data store, Document database and Column Family Data store, Comparison of NoSQL databases w.r.t CAP theorem and ACID properties.	08	CO6



Text Books:

1. Korth, Silberchatz, Sudarshan, “Database System Concepts”, 6th Edition, McGraw – Hill
2. Elmasri and Navathe, “Fundamentals of Database Systems”, 5th Edition, Pearson education.

Reference Books:

1. Dr. P.S. Deshpande, “SQL and PL/SQL for Oracle” 10g, Black Book, Dreamtech Press.
2. Gillenson, Paulraj Ponniah, “Introduction to Database Management”, Wiley Publication.
3. Ozsu, M. Tamer, Valduriez, Patrick, “Principles of Distributed Database Systems”, 3rd Edition, Pearson Education.



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Tutorial	Total
FY-MCA-S1-4	Research Methodology	04	-	-	04	-	04

Prerequisites: Basic knowledge of Mathematics for Data Analysis, Software, Internet

Course Objectives:

1. Understand Research and Research Process and their types
2. Acquaint students with identifying problems for research
3. Explain the various research strategies and apply them to various research problems

Course Outcome: Learner will be able to

1. CO 1: Demonstrate knowledge of research concepts and processes
2. CO 2: Compare and contrast quantitative and qualitative research
3. CO 3: Perform literature reviews, prepare the key elements of a research proposal
4. CO 4: Define and develop a possible research interest area using specific research design
5. CO 5: Explain the rationale for research ethics, and its importance
6. CO 6: Demonstrate enhanced writing skills



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction and Basic Research Concepts: Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods Vs Methodology, Need of Research in Business and Social Sciences, Objectives of Research , Issues and Problems in Research Self-Learning topics: Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09	CO1
2	Module 2: Research types and Design: Basic Research , Applied Research , Descriptive Research, Analytical Research , Empirical Research ,Qualitative and Quantitative Approaches Research Design: Meaning, Types and Significance , Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors Self-Learning topics: Types of Sampling	09	CO2
3	Module 3: Research Methodology: Meaning of Research Methodology ,Stages in Scientific Research Process: Identification and Selection of Research Problem , Formulation of Research Problem , Review of Literature , Formulation of Hypothesis , Formulation of research Design , Sample Design , Data Collection , Data Analysis , Hypothesis testing and Interpretation of Data , Preparation of Research Report Self-Learning topics: Types of Hypothesis	09	CO3
4	Module 4: Formulating Research Problem: Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization , Interpretation, and analysis Validity Testing Self-Learning topics: Importance of interpretation	06	CO4



5	Module 5: Ethics: Ethical Issues, Ethical Committees, Commercialization, copy right, royalty, Intellectual Property rights and patent law, Track Related aspects of intellectual property Rights, Reproduction of published material, Plagiarism, Citation and Acknowledgement ,Reproducibility and accountability. Self-Learning topics: Steps of patent filing	06	CO5
6	Module 6: Testing & Report writing: Preparation of the report on conclusion reached , Suggestions and Recommendation	06	CO6



Text Books:

1. Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.
3. Kumar Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Reference Books:

1. Pruzan, Peter , Research Methodology, The Aims, Practices and Ethics of Science , ISBN 978- 3-319-27167-5
2. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors
3. Wadehra, B.L.2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.



Subject Code	Subject Name	Teaching Scheme (Contact Hours 30)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S1-5	Web Technologies	2	0	--	02	02

Prerequisites:

1. Basic understanding of programming fundamentals
2. Familiarity with HTML and CSS (basic structure and styling)
3. Exposure to any programming language (e.g., C, Java, Python)
4. Basic understanding of how web browsers and servers communicate

Course Objectives:

1. Introduce the fundamental concepts of web technologies and client-server architecture
2. Enable students to create dynamic, interactive web pages using HTML, CSS, and JavaScript
3. Provide theoretical understanding of web forms, DOM manipulation, and event handling
4. Introduce core concepts of front-end and back-end integration
5. Discuss foundational elements of web hosting, HTTP protocol, and web security principles
6. Equip students to analyze and design basic web applications using current technologies

Course outcomes: After completion of the course, learner should be able to

1. **CO 1:** Explain the architecture of the web and the role of client-server models
2. **CO 2:** Design and structure static web pages using HTML and CSS with responsive layouts
3. **CO 3:** Apply JavaScript for DOM manipulation, form validation, and event handling
4. **CO 4:** Analyze the working of web forms and client-side scripting
5. **CO 5:** Describe server-side fundamentals and integration with databases (conceptually)
6. **CO 6:** Discuss key issues related to web performance, hosting, and security



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Fundamentals of Web Technologies Introduction to the Internet and WWW; Basics of how the web works; Client-server architecture; HTTP and HTTPS protocols; Introduction to web servers and hosting models; Static vs. dynamic websites Self-Learning Topics: Domain Name System (DNS), URL structure	06	CO1
2	Module 2: HTML5 – Structure and Semantics HTML syntax, tags, and attributes; Page layout and structure using semantic tags (<header>, <footer>, <section>, <article>); Lists, tables, forms, and input elements; Embedding multimedia (audio, video, iframe) Self-Learning Topics: HTML5 validation attributes	09	CO2
3	Module 3: CSS – Styling Web Pages CSS syntax, selectors, and properties; Inline, internal, and external CSS; Box model, margin, padding, borders; Layout using Flexbox and Grid; Media queries for responsive design Self-Learning Topics: CSS transitions and simple animations	09	CO2
4	Module 4: JavaScript – Client-Side Scripting JavaScript basics: variables, data types, operators; Control structures, functions, and scope; Arrays and objects; DOM manipulation; Event handling; Form validation Self-Learning Topics: ES6+ concepts like arrow functions, let/const	09	CO3
5	Module 5: Web Application Architecture and Backend Overview Introduction to frontend vs backend; Overview of server-side scripting languages (PHP, Node.js – concept only); Database connectivity overview; Web application flow and security essentials (authentication, sessions) Self-Learning Topics: RESTful APIs overview	06	CO4
6	Module 6: Web Hosting and Optimization Types of hosting services (shared, VPS, cloud); Domain registration; Steps for	06	CO5



	deploying a website; Website performance and optimization strategies; Version control basics (Git – conceptual) Self-Learning Topics: Accessibility and SEO fundamentals		
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Text Book:

1. **Achyut Godbole and Atul Kahate.** (2013). *Web Technologies: TCP/IP, Web/Java Programming and Cloud Computing*, McGraw-Hill Education.
2. **Kogent Learning Solutions Inc.** (2009). *Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and Ajax, Black Book*, Dreamtech Press.
3. **Thomas A. Powell.** (2010). *HTML & CSS: The Complete Reference*, 5th Edition, McGraw-Hill Education.

Reference Book:

1. **Jon Duckett.** (2014). *HTML and CSS: Design and Build Websites*, Wiley India Pvt. Ltd.
2. **Robin Nixon.** (2021). *Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5*, 6th Edition , O'Reilly Media.
3. **David Flanagan.** (2020). *JavaScript: The Definitive Guide*, 7th Edition, O'Reilly Media.
4. **Freeman and Robson.** (2014). *Head First HTML and CSS*, 2nd Edition, O'Reilly Media.



Subject Code	Subject Name	Teaching Scheme (Contact Hours 30)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S1-6	Python Programming	04	-	-	04	04

Prerequisites:

1. A basic understanding of programming concepts
2. Familiarity with at least one programming language (e.g., C, Java)
3. Foundational knowledge of algorithms and data structures

Course Objectives:

1. Introduce the core syntax, semantics, and features of Python programming
2. Develop a solid understanding of control flow, functions, and modular programming in Python
3. Explore the use of Python for solving algorithmic problems using built-in data structures
4. Familiarize students with the theoretical underpinnings of object-oriented programming (OOP) in Python
5. Discuss practical case studies and applications of Python in automation, data processing, and text parsing
6. Enhance problem-solving and analytical thinking using Python as a medium for conceptual learning

Course Outcome: Learner will be able to

1. CO 1: Explain the syntax, semantics, and structure of Python code for various programming scenarios
2. CO 2: Analyze and design algorithmic solutions using Python's control structures and built-in functions
3. CO 3: Illustrate the use of Python data types and data structures (lists, tuples, dictionaries, sets) in theoretical scenarios
4. CO 4: Describe the principles of object-oriented programming in Python and apply them to conceptual problems
5. CO 5: Evaluate real-world use cases where Python is used for automation, file processing, or text analysis
6. CO 6: Articulate Python solutions clearly in written format, including algorithm steps, flowcharts, and pseudocode



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to Python Programming Introduction to Python: History, features, installation, IDEs; Syntax, variables, keywords, identifiers, input/output, data types, type conversion; Operators and expressions; Basics of code structuring in Python Self-Learning Topics: Dynamic typing and Python's execution model	09	CO1
2	Module 2: Control Structures and Functions Decision-making (if, if-else, elif); Loops (for, while); Loop control statements (break, continue, pass); Introduction to functions; Defining and calling functions, function arguments, return values, recursion Self-Learning Topics: Python built-in functions	09	CO2
3	Module 3: Data Structures and String Handling in Python Strings, lists, tuples, sets, and dictionaries; Operations on each structure, comprehensions, nested structures, slicing, indexing; Iterating and membership testing Self-Learning Topics: Mutable vs Immutable types in Python	09	CO3
4	Module 4: Object-Oriented Programming in Python Introduction to OOP in Python; Classes and objects, constructors, attributes, methods; Inheritance, polymorphism, encapsulation; Use cases and theoretical applications Self-Learning Topics: Special methods (__init__, __str__, etc.)	06	CO4
5	Module 5: File Handling and Regular Expressions File I/O operations: open(), read(), write(), append(), close(); Working with text and binary files; Exception handling in Python; Regular expressions: pattern matching, search, match, replace Self-Learning Topics: Text parsing for log analysis	06	CO5
6	Module 6: Python Applications and Problem Solving Overview of real-world use cases: automation, data collection, data filtering; Basics of web scraping (conceptual), API handling (theory); Case studies and problem-solving scenarios discussed	06	CO6



	theoretically Self-Learning Topics: Use of Python in AI, data science, and scripting		
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Text Book:

1. **Guttag, John V.** (2016). *Introduction to Computation and Programming Using Python: With Application to Understanding Data*, 2nd Edition, MIT Press.
2. **Zelle, John M.** (2010). *Python Programming: An Introduction to Computer Science*, 2nd Edition, Franklin, Beedle & Associates Inc.
3. **Taneja, Reema.** (2021). *Python Programming*, 1st Edition, Oxford University Press.

Reference Book:

1. **Lutz, Mark.** (2013). *Learning Python*, 5th Edition, O'Reilly Media.
2. **Summerfield, Mark.** (2009). *Programming in Python 3: A Complete Introduction to the Python Language*, 2nd Edition, Addison-Wesley.
3. **Schildt, Herbert.** (2019). *Python: The Complete Reference*, McGraw-Hill Education.



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Semester - II Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S2-7	Analysis of Algorithm	04	-	-	04	04

Prerequisites: Data Structures

Course Objectives:

1. To provide mathematical approach for Analysis of Algorithms
2. To solve problems using various strategies
3. To analyse strategies for solving problems not solvable in polynomial time.

Course Outcome: Learner will be able to

1. CO1: Analyze the running time and space complexity of algorithms.
2. CO2: Describe, apply and analyze the complexity of divide and conquer strategy.
3. CO 3: Describe, apply and analyze the complexity of greedy strategy.
4. CO 4: Describe, apply and analyze the complexity of dynamic programming strategy.
5. CO 5: Explain and apply backtracking, branch and bound and string-matching techniques to deal with some hard problems.
6. CO 6: Describe the classes P, NP, and NP-Complete and be able to prove that a certain problem is NP-Complete



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction: Algorithm analysis, Asymptotic Notations, Recurrences. Methods for finding complexity of recursive algorithms, Analysis of selection and insertion sort.	08	CO1
2	Binary search, Quick sort, Merge Sort Analysis of all algorithms.	05	CO2
	Greedy Design Strategies: Elements of Greedy Strategy, Minimum cost spanning tree algorithms, Dijkstra's Shortest Path Algorithm, Job Sequencing with deadline, Knapsack Problem	07	CO3
3	Dynamic programming: Elements of Dynamic programming, Multistage graphs, Bellman ford single source shortest path, Floyds Warshall's all pair shortest path algorithm, Travelling salesman problem, 0-1Knapsack Problem, LCS.	07	CO4
4	Backtracking and Branch and-bound: N-queens problem, Sum of subsets, Graph coloring, Traveling Salesperson Problem, 15 Puzzle Problem.	07	CO5
5	String Matching Algorithms: Naïve, Rabin Karp, Finite automata, Knuth-Morris-Pratt.	05	CO5
6	NP Completeness: P, NP, and NP-complete Problems. Vertex Cover, Hamiltonian Cycle and Traveling Salesman Problems.	05	CO6



Textbooks:

1. T.H.Coreman, C.E. Leiserson,R.L. Rivest, and C. Stein, “Introduction to algorithms”, 2nd edition, PHI publication 2005.
2. Ellis Horowitz, Sartaj Sahni , S. Rajsekaran. “Fundamentals of computer algorithms”, University Press.

Reference Books:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw- Hill Edition.
2. S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI.
3. John Kleinberg, Eva Tardos, “Algorithm Design”, Pearson.
4. Michael T. Goodrich, Roberto Tamassia, “Algorithm Design”, Wiley Publication



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S2-8	Artificial Intelligence and Machine Learning	04	-	-	04	04

Prerequisites: Basics of data mining and Mathematical foundations of computer science

Course Objectives:

1. Understand different AI concepts
2. Elucidate knowledge of Artificial Intelligence techniques for problem solving
3. Understand Artificial intelligence search strategies and neural networks
4. Provide an insight into the fundamentals of Machine Learning Techniques
5. Become familiar with regression methods, classification methods, clustering methods
6. Become familiar with methods to improve the learning

Course Outcome: Learner will be able to

1. CO 1: Interpret Artificial Intelligence concepts.
2. CO 2: Apply Artificial intelligence techniques for problem solving
3. CO 3: Analyze the working of Artificial Neural Networks.
4. CO 4: Analyze the fundamentals of machine learning, the learning algorithms and the paradigms of supervised and un-supervised learning
5. CO 5: Identify methods to improve machine learning results for better predictive performance
6. CO 6: Analyze various feature selection techniques.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction: Artificial Intelligence, Application of AI, AI Problems, Problem Formulation, Intelligent Agents, Types of Agents, Agent Environments, PEAS representation for an Agent, Architecture of Intelligent agents. Reasoning and Logic, Propositional logic, First order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining	06	CO1
2	Search Strategies: Solving problems by searching, Search-Issues in The Design of Search Programs, Un-Informed Search- BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, Alpha beta search algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis	09	CO2
3	Artificial Neural Networks : Introduction, Activation Function, Optimization algorithm- Gradient decent, Networks- Perceptrons, Adaline, Multilayer Perceptrons , Backpropagation Algorithms Training Procedures, Tuning the Network Size	07	CO3
4	Introduction to ML: Machine Learning basics, Applications of ML, Data Mining Vs Machine Learning vs Big Data Analytics. Supervised Learning- Naïve Base Classifier, Classifying with k- Nearest Neighbour classifier, Decision Tree classifier, Unsupervised Learning - Grouping unlabeled items using k- means clustering, Association analysis with the Apriori algorithm Introduction to reinforcement learning	09	CO4



5	Kernel Machines & Ensemble Methods Introduction, Optimal Separating Hyperplane, Separating data with maximum margin, Support Vector Machine (SVM), Finding the maximum margin, The Non-Separable Case: Soft Margin Hyperplane, Kernel Trick, Defining Kernels Ensemble Methods : Mixture Models, Classifier using multiple samples of the data set, Improving classifier by focusing on error, weak learner with a decision stump, Bagging , Stacking, Boosting ,Implementing the AdaBoost algorithm, Classifying with AdaBoost Bootstrapping and cross validation	09	CO5
6	Dimensionality Reduction: Introduction, Subset Selection, Principal Components Analysis, Multidimensional Scaling, Linear Discriminant Analysis.	05	CO6

Text Books:

1. George F Luger, Artificial Intelligence, Fifth Edition-2009, Pearson Education Publications ,ISBN-978-81-317-2327-2
2. Stuart Russell, Peter Norvig ,Artificial Intelligence – A Modern Approach, Pearson Education / Prentice Hall of India, 3rd Edition, 2009 .ISBN- 13: 978- 0136042594
3. EthemAlpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81- 203- 5078-6

Reference Books:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Mcgraw- Hill, ISBN No. 978-81-322-0906-5
2. Tom Mitchell, Machine Learning, Mcgraw-Hill, First Edition, ISBN No. 0-07- 115467-1.



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Tutorial	Total
FY-MCA-S2-9	Project Management	04	-	-	04	04	04

Prerequisites: Basics of data mining and Mathematical foundations of computer science

Course Objectives:

1. Understand the concepts of Software Engineering and Project Management.
2. Familiarize Project Management framework and Tools.
3. Apply knowledge of Project Life Cycle to implement the projects.
4. Apply the requirement specification and designing tools along with UML.
5. Understand the techniques of project scheduling & project implementation.
6. Learn software cost estimation and software quality assurance techniques.

Course Outcome: Learner will be able to

1. CO 1: Define the key concepts of Software Project Management.
2. CO 2: Demonstrate understanding of the requirements Analysis and Application of UML Models.
3. CO 3: Make use of estimation logic for estimation of software size as well as cost of software.
4. CO 4: Examine the need of change management during software development as well as application of quality tools.
5. CO 5: Assess various factors influencing project management, quality assurance and risk assessment.
6. CO 6: Develop process for successful quality project delivery.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: An Overview of Software Project Management: Introduction to Project, Project Management, Difference between Software Engineering & Software Project Management. An Overview of IT Project Management: Define project, project management framework, The role of project Manager, Systems View of Project Management, Stakeholder management, Leadership in Projects: Modern Approaches to Leadership & Leadership Styles. Self-Learning topics: Evolving role of software.	06	CO1
2	Module2: Software Process Models: Project phases and the project life cycle, Waterfall Model, Evolutionary Process Model: Prototype and Spiral Model, Incremental Process model: Iterative approach, RAD model, Agile Development Model: Extreme programming, Scrum. Self-Learning topics: JAD & DevOps Model, Comparison among models.	08	CO2
3	Module 3: Software Requirement Analysis and Design: Types of Requirements, Feasibility Study, Requirement Elicitation Techniques: Interviews, Questionnaire, Brainstorming, Facilitated Application Specification Technique (FAST), Requirement Analysis and Design: Data Flow Diagram (DFD), Data Dictionary, Software Requirement Specification (SRS). Object Oriented Analysis and Design: UML Overview, The Nature and purpose of Models, UML diagrams (Use Case diagram, Activity Diagram, Class & Object Diagram, Sequence Diagram, State Transition Diagram, Deployment Diagram). Self-Learning Topics: Comparison of Requirements Elicitation Techniques.	08	CO3



4	Module 4: Software Project Planning & Software Cost Estimation: Business Case, Project selection and Approval, Project charter, Project Scope management, Creating the Work Breakdown Structures (WBS). Software Estimation: Size Estimation: Function Point (Numerical). Cost Estimation: COCOMO (Numerical), COCOMO-II (Numerical) till Early design model. Self-Learning Topics: COCOMO II Post- Architecture model.	08	CO4
5	Module 5: Project Scheduling and Procurement Management: Relationship between people and Effort: Staffing Level Estimation, Effect of schedule Change on Cost, Project Schedule, Schedule Control, Critical Path Method (CPM) (Numerical), Basics of Procurement Management, Change Management. Self- Learning Topics: Degree of Rigor.	06	CO5
6	Module 6: Software Quality Assurance: Software and System Quality Management: Overview of ISO 9001, SEI Capability Maturity Model, McCalls Quality Model, Six Sigma, Formal Technical Reviews, Tools and Techniques for Quality Control, Pareto Analysis, Statistical Sampling, Quality Control Charts and the seven Run Rule. Software Risk Management: Identify IT Project Risk, Risk Analysis and Assessment, Risk Strategies, Risk Monitoring and Control, Risk Response and Evaluation. The Project Implementation Plan and Closure: Project Implementation Administrative Closure. Self-Learning Topics: Software Reliability Metrics, Reliability Growth Modeling	09	CO6



Text Books:

1. Software Engineering, 5th and 7th edition, by Roger S Pressman, McGraw Hill publication.
2. Managing Information Technology Project, 6edition, by Kathy Schwalbe, Cengage Learning publication.
3. Information Technology Project Management by Jack T Marchewka Wiley India publication.

Reference Books:

1. Software Engineering 3rd edition by KK Agrawal, Yogesh Singh, New Age International publication.
2. The Unified Modelling Language Reference manual, Second Edition, James
3. Rumbaugh, Iver Jacobson, Grady Booch, Addition- Wesley.
4. Object-Oriented Modeling and Design with UML, Michael Blaha, James Rumbaugh, PHI(2005).



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S2-10	Natural Language Processing	04	-	-	04	04

Prerequisites:

Probability, Python programming, Data structure & Algorithms

Course Objectives:

1. Understand natural language processing and to learn how to apply basic algorithms in this field.
2. Get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3. Implement a rule based system to tackle morphology/syntax of a Language.
4. Compare and contrast use of different statistical approaches for different types of applications
5. Design a tag set to be used for statistical processing keeping an application in mind, design a Statistical technique for a new application.
6. Design an innovative application using NLP components.

Course Outcome: Learner will be able to

1. CO 1: Understand the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
2. CO 2: Understand the information retrieval techniques using NLP.
3. CO 3: Apply mathematical techniques that are required to develop NLP applications.
4. CO 4: Analyze various NLP algorithms and text mining NLP applications.
5. CO 5: Analyze text for categorization and summarization using different optimizations.
6. CO 6: Design real world NLP applications sentiment analysis and Opinion Mining.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1: Introduction: History of NLP, Generic NLP system, levels of NLP , Knowledge in language processing, Ambiguity in Natural language , stages in NLP, challenges of NLP, Applications of NLP Self-Learning topics: Empirical laws	05	CO1
2	Module2: Word Level Analysis: Morphology analysis – survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST) , Morphological parsing with FST, Lexicon free FST Porter stemmer. N –Grams- N-gram language model Self-Learning topics: N-gram for spelling correction	09	CO2
3	Module3: Syntax analysis: Part-Of-Speech tagging(POS)- Tag set for English (Penn Treebank) , Rule based POS tagging, Stochastic POS tagging, Issues – Multiple tags & words, Unknown words. Introduction to CFG, Sequence labeling: Hidden Markov Model (HMM), Maximum Entropy Self-Learning topics: Conditional Random Field (CRF)	09	CO3
4	Module4: Introduction to ML: Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, Robust Word Sense Disambiguation (WSD), Dictionary based approach Self-Learning topics: WordNet	10	CO4
5	Module5: Text Summarization, Text Classification: Text summarization- LEXRANK, Optimization based approaches for summarization, Summarization evaluation, Text classification Self-Learning topics: NLKT, Naïve Bayes Theorem	07	CO5



6	Module6: Sentiment Analysis and Opinion Mining: Sentiment Analysis introduction, Sentiment Analysis - Affective lexicons, Learning affective lexicons, Computing with affective lexicons, Aspect based sentiment analysis Self-Learning topics: Named Entity Recognition	05	CO6
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Text Books:

1. Dan Jurafsky and James Martin. “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice Hall, Second Edition, 2009.
2. Steven Bird, Ewan Klein, Natural Language Processing with Python, O’Reilly.
3. Christopher D.Manning and HinrichSchutze, — Foundations of Statistical Natural Language Processing —, MIT Press, 1999.
4. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
5. Daniel M Bikel and ImedZitouni — Multilingual natural language processing applications|| Pearson, 2013.
6. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) — The Handbook of Computational Linguistics and Natural Language Processing.
7. Brian Neil Levine, An Introduction to R Programming.
8. Niel J le Roux, SugnetLubbe, A step by step tutorial : An introduction into R application and programming Stuart Russell, Peter Norvig ,Artificial Intelligence – A Modern Approach, , Pearson Education / Prentice Hall of India, 3rd Edition, 2009.



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S2-11	Enterprise Resource Planning (ERP)	04	-	0	04	04

Prerequisites: None

Subject Objectives:

1. To understand the fundamental concepts of Enterprise Resource Planning (ERP) systems.
2. To gain knowledge of the various Enterprise Resource Planning (ERP) modules and their functionalities.
3. To comprehend the process of Enterprise Resource Planning (ERP) implementation and post- implementation activities.

Subject Outcome: Learner will be able to

1. CO 1: Understand fundamental concept of Enterprise Resource Planning (ERP) System.
2. CO 2: Gain the Knowledge about business process of Enterprise Resource Planning (ERP) System
3. CO 3: Evaluate the Modules and Functionality using Supply chain
4. CO 4: Formulate the Customer relationship management for Enterprise Resource Planning (ERP) system
5. CO 5: Develop Enterprise Resource Planning (ERP) Implementation using different tools
6. CO 6: Recognize various application of Enterprise Resource Planning (ERP) using case studies.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1: Introduction: Introduction to Enterprise Resource Planning (ERP), Definition and Concept of ERP, Evolution of ERP Systems, Benefits of ERP, Sales and Marketing ERP Systems: Accounting and finance, ERP Systems: Production and Materials Management ERP Systems: Human Resources, ERP System Architecture Self-Learning topics:	09	CO1
2	Module2: ERP and Business Processes: Business Processes: Definition and Importance, Business Process Reengineering (BPR), ERP and Business Process Integration, Role of ERP in Business Process Improvement Self-Learning topics: Business Process	06	CO2
3	Module3: Modules and Functionality Supply chains as Systems, Modeling the Supply Chain, Supply Chain Software, Operations, Meeting Demand, Maintaining Supply, Measuring Performance, Planning: Forecasting Demand, Scheduling Supply, improving performance, Mastering Demand, Designing the Chain, Maximizing Performance Self-Learning topics: Supply Chain implementation	09	CO3
4	Module4: Customer relationship management Essentials of Customer relationship management, Designing CRM application, Various modules of CRM application, Advantages of CRM Self-Learning topics: CRM Strategies and Tools	06	CO4
5	Module5:: ERP Implementation ERP Implementation Life Cycle, Pre-implementation Activities ERP Project Management, Critical Success Factors in ERP Implementation, ERP Implementation Challenges and Solutions Post-implementation Activities, ERP Software Selection, ERP	09	CO5



	and Cloud Computing, Mobile ERP Solutions, ERP and Internet of Things (IoT), Role of Artificial Intelligence in ERP Self-Learning topics: ERP and Big Data Analytics		
6	Module6: ERP Case Studies and Applications Case Studies of Successful ERP Implementations, Case Studies of ERP Failures, ERP in Small and Medium Enterprises (SMEs), ERP in Large Enterprises, Sector-specific ERP Solutions Self-Learning topics: ERP Integration with E-commerce	06	CO6

TEXTBOOK:

1. Sumner Mary, Enterprise Resource Planning, First edition, Pearson education, 2006.
2. Taylor David A., Supply Chains (A manager's guide), Pearson education, 2004.
3. Tiwana, Essential guide to knowledge management: The e-business and CRM applications, Pearson education.
4. "Enterprise Resource Planning Systems: Systems, Life Cycle, Electronic Commerce, and Risk" by Daniel E. O'Leary.

REFERENCE BOOK:

1. ALTEKAR Rahul V., Enterprise wide resource planning (Theory and practice), Prentice Hall of India, 2005.
2. Garg Vinod K & Venkitakrishnan N.K, Enterprise resource planning, Second edition, Prentice Hall of India, 2006.
3. Handfield R. B & Nichols. Ernest L., Introduction to supply chain management, Prentice Hall of India, 2006.
4. Thomas F. Wallace and Michael H. Kremzar “ ERP: Making It Happen: The Implementers' Guide to Success with Enterprise Resource Planning", 2012.



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theor y	Practical	Tutorial	Theory	Tota l
FY-MCA-S2-12	Big Data Analytics	04	-	-	04	04

Prerequisites: Basics of data mining and Mathematical foundations of computer science

Subject Objectives:

1. Provide an overview of the exciting and growing field of big data analytics.
2. Enhance programming skills using big data technologies such as map-reduce, NoSQL, Hive, Pig.
3. Use Spark Shell to explore distributed data.
4. Use Spark shell and Spark applications to process, and analyze distributed data.
5. Teach the component of visualization.
6. Understand why visualization is important for data analysis.

Subject Outcome: The learner will be able to

1. CO 1: Demonstrate the key issues in big data management.
2. CO 2: Demonstrate the big data management applications for business decisions.
3. CO 3: Develop problem-solving and critical thinking skills in fundamental enabling techniques like Map Reduce, NoSQL, and Hadoop Ecosystem.
4. CO 4: Use of RDD and Data Frame to create Applications in Spark.
5. CO 5: Demonstrate the use of Apache Kafka in social media applications.
6. CO 6: Implement exploratory data analysis using visualization



Module No.	Detailed Content	Hours	CO Mapping
1	Module1: Introduction to Big Data and Hadoop: Introduction to Big Data, Big Data Characteristics, Types of Big Data, Traditional vs. Big Data, Big Data Applications. Hadoop architecture: HDFS, YARN 2, YARN Daemons. Hadoop Ecosystem. Self-Learning Topics: Yet Another Resource Negotiator YARN 1.X	06	CO1
2	Module2: HDFS and Map Reduce HDFS: HDFS architecture, Features of HDFS, Rack Awareness, HDFS Federation Map Reduce: The Map Task, The Reduce Task, Grouping by Key, Partitioner, and Combiners, Detail of Map Reduce Execution. Algorithm Using Map Reduce: Matrix and Vector Multiplication by Map Reduce Computing Selection and Projection by Map Reduce Computing Grouping and Aggregation by Map Reduce Self-Learning Topics: Concept of Sorting and Natural Joins	09	CO2
3	Module3: NoSQL Introduction to NoSQL, No SQL Business drivers NoSQL Data architecture patterns: key-value stores, Column family Stores, Graph Stores, and Document Stores. NoSQL to manage big data: Analyzing big data with shared nothing architecture, choosing distribution master slave vs. peer to peer. HBASE overview, HBASE data model, Read Write architecture. Self-Learning Topics: Cassandra Case Study	09	CO3



4	Module4: Hadoop Ecosystem: HIVE and PIG HIVE: background, architecture, warehouse directory and meta-store, HIVE query language, loading data into a table, HIVE built-in functions, joins in HIVE, Partitioning. HiveQL: querying data, sorting and aggregation, PIG: background, architecture, PIG Latin Basics, PIG execution modes, PIG processing – loading and transforming data, PIG built-in functions, filtering, grouping, sorting data Installation of PIG and PIG Latin commands. Self-Learning Topics: Cloudera IMPALA	07	CO4
5	Module5: Apache Kafka: Kafka Fundamentals, Kafka architecture, Case Study: Streaming real-time data (Read Twitter Feeds and Extract the Hashtags) Apache Spark: Spark Basics, Working with RDDs in Spark, Spark Framework, aggregating Data with Pair RDDs, Writing and Deploying Spark Applications, Spark SQL, and Data Frames. Self-Learning Topics: KMeans and Page Rank in Apache Spark	07	CO5
6	Module6: Data Visualization: Explanation of data visualization, Challenges of big data visualization, Approaches to big data visualization, D3 and big data, getting started with D3, Another twist on bar chart visualizations, Tableau as a Visualization tool, Dashboards for Big Data - Tableau. Self-Learning Topics: Splunk via web Interface.	07	CO6



Text Books:

1. Tom White, “HADOOP: The definitive Guide” O Reilly 2012, Third Edition, ISBN: 978-1-449-31152-0
2. Chuck Lam, “Hadoop in Action”, Dreamtech Press 2016, First Edition ,ISBN:139788177228137
3. Shiva Achari,” Hadoop Essential “ PACKT Publications, ISBN 978-1-78439-668-8
4. Radha Shankarmani and M. Vijayalakshmi ,”Big Data Analytics “Wiley Textbook Series, Second Edition, ISBN 9788126565757
5. Jeffrey Aven,”Apache Spark in 24 Hours” Sam’s Publication, First Edition, ISBN: 0672338513
6. Bill Chambers and Matei Zaharia,”Spark: The Definitive Guide: Big Data Processing Made Simple “O’Reilly Media; First edition, ISBN-10: 1491912219;
7. James D. Miller,” Big Data Visualization” PACKT Publications.ISBN-10: 1785281941

Web References:

1. <https://hadoop.apache.org/docs/stable/>
2. <https://pig.apache.org/>
3. <https://hive.apache.org/>
4. <https://spark.apache.org/documentation.html>
5. <https://help.tableau.com/current/pro/desktop/en-us/default.htm>



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Elective: General

Semester - III

Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-13	Applied Data Analytics with Python	4	-	-	4	4

Prerequisites:

1. Basic understanding of Python programming and data handling.
2. Knowledge of statistics, probability, and basic mathematics for data analysis.

Subject Objectives:

1. To understand the principles and methods of data analytics using Python.
2. To apply Python libraries and tools for data collection, cleaning, transformation, and visualization.
3. To explore machine learning techniques for predictive and prescriptive analytics.
4. To implement end-to-end analytics workflows for business and research problems.
5. To evaluate and communicate data-driven insights effectively.

Subject Outcome: Learner will be able to

1. CO1: Perform data acquisition, cleaning, and preprocessing using Python.
2. CO2: Apply data visualization techniques using Python libraries to explore and present data.
3. CO3: Implement statistical and exploratory data analysis techniques.
4. CO4: Build and evaluate machine learning models for prediction and classification tasks.
5. CO5: Apply advanced analytics techniques such as clustering, recommendation, and time-series forecasting.
6. CO6: Develop complete data analytics projects integrating multiple stages of the workflow.
7. CO7: Interpret and present findings using best practices in data storytelling.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Data Acquisition and Preprocessing Introduction to Data Analytics; Role of Python in Data Analytics; Data types and structures in Python; Data import from CSV, Excel, SQL, APIs, Web Scraping; Handling missing data, outliers, and duplicates; Data transformation, encoding categorical variables, scaling, and normalization. Self-learning topics: Pandas I/O functions, datetime handling.	07	CO1
2	Module 2: Data Visualization with Python Principles of data visualization; Using Matplotlib and Seaborn for univariate, bivariate, and multivariate visualizations; Customizing plots; Interactive visualizations with Plotly; Visual storytelling techniques. Self-learning topics: Dashboard creation with Streamlit.	07	CO2
3	Module 3: Statistical and Exploratory Data Analysis Descriptive statistics, probability distributions, hypothesis testing; Correlation and covariance; Feature selection and dimensionality reduction (PCA). Self-learning topics: Non-parametric tests in Python.	07	CO3
4	Module 4: Machine Learning with Python Supervised learning – Regression and Classification (Linear Regression, Logistic Regression, Decision Trees, Random Forests, SVM, k-NN); Model evaluation and performance metrics; Overfitting and regularization. Self-learning topics: Cross-validation techniques.	09	CO4
5	Module 5: Advanced Analytics Techniques Unsupervised learning – Clustering (K-Means, Hierarchical); Recommendation systems (content-based, collaborative); Time series analysis and forecasting (ARIMA, Prophet). Self-learning topics: Anomaly detection in Python.	07	CO5



6	Module 6: Applied Data Analytics Project Integration of data acquisition, preprocessing, EDA, visualization, and machine learning into a complete analytics workflow; Case studies in business, social media, healthcare, and finance; Communication of insights through reports and dashboards. Self-learning topics: Best practices in model deployment.	08	CO6
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Text Books:

1. Wes McKinney, *Python for Data Analysis*, O'Reilly Media, 2nd Edition, ISBN: 9781491957660
2. Jake VanderPlas, *Python Data Science Handbook*, O'Reilly Media, ISBN: 9781491912058
3. Sebastian Raschka, *Python Machine Learning*, Packt Publishing, 3rd Edition, ISBN: 9781801819312
4. Joel Grus, *Data Science from Scratch*, O'Reilly Media, 2nd Edition, ISBN: 9781492041139
5. Allen B. Downey, *Think Stats: Exploratory Data Analysis in Python*, O'Reilly Media, ISBN: 9781491907337

Reference Books:

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly Media, 2nd Edition, ISBN: 9781492032649
2. Prateek Joshi, *Artificial Intelligence with Python*, Packt Publishing, ISBN: 9781786464392
3. Hadley Wickham & Garrett Grolemund, *R for Data Science* (for comparative study), O'Reilly Media, ISBN: 9781491910399
4. Andrea Giussani, *Data Analysis with Python and PySpark*, Packt Publishing, ISBN: 9781801072601
5. Ashish Kumar, *Mastering Python for Data Science*, Packt Publishing, ISBN: 9781783553297

Web References:

1. <https://pandas.pydata.org>
2. <https://scikit-learn.org>
3. <https://matplotlib.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-14	DevOps Foundations: Version Control & CI/CD Tools	04	-	-	04	04

Prerequisites:

1. Basic understanding of software development lifecycle
2. Familiarity with command-line tools and scripting basics

Subject Objectives:

1. To introduce the principles and practices of DevOps methodology
2. To provide hands-on knowledge of Git-based version control systems
3. To understand Continuous Integration and Continuous Delivery (CI/CD) pipelines
4. To explore DevOps tools used in automation and deployment processes
5. To equip students to work in collaborative, automated DevOps environments

Subject Outcome: Learner will be able to

1. CO1: Understand DevOps fundamentals and its impact on the SDLC
2. CO 2: Perform source code versioning using Git and GitHub in a team-based workflow
3. CO 3: Configure and manage build automation using CI tools such as Jenkins or GitHub Actions
4. CO 4: Set up and manage containerized applications using Docker
5. CO 5: Apply basic Infrastructure-as-Code (IaC) using tools like Terraform or YAML in CI/CD pipelines
6. CO 6: Integrate DevOps tools for end-to-end software delivery and deployment



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to DevOps DevOps Overview, Principles, and Lifecycle; Benefits of DevOps Culture; Agile vs DevOps; DevOps and SDLC; Key Components: CI, CD, IaC, Monitoring; Toolchain Overview Self-learning topics: DevOps Case Studies from Industry	06	Agile vs Toolchain CO1
2	Module 2: Version Control with Git and GitHub Introduction to Git: Installation, Configuration, and Workflow; Git Add, Commit, Push, Pull; Branching and Merging Strategies; Git Forks, Pull Requests, Issues, Actions; Git Ignore and Git Rebase Self-learning topics: Git Hooks, Semantic Versioning	09	CO2
3	Module 3: Continuous Integration (CI) Principles of CI; Jenkins Basics and Setup; Job Configuration, Pipelines, and Builds; GitHub Actions – Workflows, Events, Jobs, Runners; CI Integration with Git Repositories; Code Coverage and Static Code Analysis Tools Self-learning topics: Environment Variables in CI Tools	07	CO3
4	Module 4: Containerization Using Docker Docker Architecture; Images and Containers; Dockerfile Creation; Image Tagging, Publishing, and Versioning; Volumes and Networking Self-learning topics: Dockerizing Full Stack Applications	07	CO4
5	Module 5: Infrastructure-as-Code and Automation IaC Concepts; YAML Basics; Introduction to Terraform and Configuration Scripts; Secrets Management; Automated Testing in Pipelines; Deployment Strategies: Blue-Green, Rolling Updates Self-learning topics: Terraform Modules and State Files	07	CO5



6	Module 6: End-to-End CI/CD Pipeline Integration Building a Complete CI/CD Pipeline; Integrating Git, Jenkins/GitHub Actions, Docker, and IaC; Notifications and Webhooks; Monitoring and Logging Basics; DevOps Security Considerations Self-learning topics: DevSecOps Overview	09	CO6
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Text Books:

1. Gene Kim, Patrick Debois, John Willis, The DevOps Handbook, IT Revolution Press, ISBN: 9781942788003
2. Karl Matthias, Sean P. Kane, Docker: Up and Running, O'Reilly Media, ISBN: 9781492036739
3. Brent Laster, Jenkins 2: Up and Running, O'Reilly Media, ISBN: 9781491979594
4. Rajesh S., Getting Started with Git and GitHub, Packt Publishing, ISBN: 9781789808974
5. Mikael Krief, Learning DevOps, Packt Publishing, ISBN: 9781800562882

Reference Books:

1. Stephen Fleming, *DevOps for Developers*, Amazon Kindle Edition
2. James Turnbull, *The Docker Book*, James Turnbull Publishing, ISBN: 9780988820203
3. Yevgeniy Brikman, *Terraform: Up and Running*, O'Reilly Media, ISBN: 9781492046906
4. Chris Dawson, *Effective DevOps with AWS*, Packt Publishing, ISBN: 9781787288297
5. Kief Morris, *Infrastructure as Code*, O'Reilly Media, ISBN: 9781491924359

Web References:

1. <https://docs.github.com/> – GitHub Docs
2. <https://www.jenkins.io/doc/> – Jenkins Documentation
3. <https://docs.docker.com/> – Docker Official Docs



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theor y	Practical	Tutorial	Theory	Total
FY-MCA-S3-15	Foundations of Cybersecurity	04	-	-	04	04

Prerequisites:

1. Basic knowledge of computer networks and operating systems
2. Familiarity with fundamental programming concepts

Subject Objectives:

1. Understand the fundamental principles and concepts of cybersecurity.
2. Identify different types of cyber threats, vulnerabilities, and attacks.
3. Learn security mechanisms, cryptographic techniques, and authentication methods.
4. Develop knowledge of security policies, standards, and best practices.
5. Apply cybersecurity concepts in real-world scenarios to secure systems and networks.

Subject Outcome: Learner will be able to

1. CO 1: Explain the foundational concepts of cybersecurity and its importance in modern computing.
2. CO 2: Identify and classify various cyber threats, vulnerabilities, and attack methods.
3. CO 3: Apply cryptographic methods and authentication techniques to protect information.
4. CO 4: Evaluate and implement network and system security controls.
5. CO 5: Interpret cybersecurity policies, standards, and legal considerations.
6. CO 6: Apply risk management and incident response techniques in practical scenarios.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Cybersecurity: Definition, Scope, and Importance; Security Goals – Confidentiality, Integrity, Availability (CIA triad); Cybersecurity Architecture; Cybersecurity Domains; Security Challenges in Cloud, Mobile, and IoT; Role of Cybersecurity in Business Continuity; Ethical and Legal Aspects in Security. Self-learning topics: Historical case studies of major cyber incidents.	06	CO1
2	Cyber Threats and Vulnerabilities: Types of threats – Malware, Phishing, Ransomware, DoS/DDoS, Advanced Persistent Threats (APTs), Insider Threats, Social Engineering; Vulnerabilities – Software flaws, Hardware weaknesses, Configuration errors, Human Factors; Threat Modeling and Attack Surface Analysis; Common Exploits and Attack Vectors. Self-learning topics: OWASP Top 10 vulnerabilities.	07	CO2
3	Cryptography and Authentication: Symmetric and Asymmetric Encryption (DES, AES, RSA, ECC), Public Key Infrastructure (PKI) and Digital Certificates, Hashing (SHA, MD5) and Message Authentication Codes, Digital Signatures, Authentication Factors – Passwords, Biometrics, Tokens, Multi-factor Authentication; Key Management Practices; Cryptographic Protocols – SSL/TLS, IPsec. Self-learning topics: Blockchain-based authentication methods.	09	CO3
4	Network and System Security: Network Segmentation, Firewalls (Packet filtering, Stateful inspection, Application-level gateways), Intrusion Detection/Prevention Systems (IDS/IPS), Virtual Private Networks (VPNs), Wireless Security (WPA3), Endpoint Security, Patch and Vulnerability Management, Host Hardening, Secure Boot, Secure Configuration Baselines. Self-learning topics: Security configurations in Linux/Windows.	07	CO4
5	Security Policies, Standards, and Compliance: Overview of Cybersecurity Governance; International Standards – ISO/IEC 27001, NIST Cybersecurity Framework; Compliance Laws – GDPR, HIPAA, PCI-DSS; Organizational Security Policies – Access Control, Acceptable Use, Data Classification; Policy Development Life Cycle; Security Awareness and Training Programs. Self-learning topics: Security audits and certifications.	06	CO5
6	Risk Management and Incident Response: Risk Assessment Methodologies (Qualitative and Quantitative), Threat Intelligence Sources, Vulnerability Scanning and Penetration Testing, Incident Response Phases	06	CO6



	(Preparation, Detection, Containment, Eradication, Recovery), Digital Forensics Basics, Evidence Handling, Disaster Recovery and Business Continuity Planning. Self-learning topics: Case study of a recent cyber breach.		
7	Emerging Trends in Cybersecurity: Cloud Security (Shared Responsibility Model, CASB tools), IoT Security Challenges and Solutions, AI and Machine Learning for Threat Detection, Zero Trust Architecture, Blockchain Applications in Security, Quantum Computing Impact on Cryptography. Self-learning topics: Predicting future threat landscapes.	08	CO1

Text Books:

1. Stallings, W., Cryptography and Network Security: Principles and Practice, Pearson.
2. Pfleeger, C. P., & Pfleeger, S. L., Security in Computing, Pearson.
3. Bishop, M., Computer Security: Art and Science, Addison-Wesley.
4. Schneier, B., Applied Cryptography, Wiley.
5. Anderson, R., Security Engineering: A Guide to Building Dependable Distributed Systems, Wiley.

Reference Books:

1. Shon Harris, CISSP All-in-One Exam Guide, McGraw-Hill.
2. Ross, J., Cybersecurity: The Essential Body of Knowledge, Cengage Learning.
3. Whitman, M. E., & Mattord, H. J., Principles of Information Security, Cengage Learning.
4. Cole, E., Network Security Bible, Wiley.
5. Kizza, J. M., Computer Network Security, Springer.

Web References:

1. <https://www.nist.gov/cyberframework>
2. <https://owasp.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-16	Foundations of Cloud Computing	04	-	-	04	04

Prerequisites:

1. Basic Networking Concepts
2. Understanding of Operating Systems
3. Familiarity with Virtualization and Web Technologies

Subject Objectives:

1. Understand the fundamental concepts and architecture of cloud computing.
2. Explore various service models: IaaS, PaaS, and SaaS.
3. Learn about virtualization and containerization technologies used in cloud.
4. Examine cloud deployment models and their real-world applications.
5. Understand security, governance, and cost models in cloud environments.
6. Explore current platforms and tools: AWS, Azure, and Google Cloud basics.

Subject Outcome: Learner will be able to

1. **CO1:** Explain the core concepts and evolution of cloud computing.
2. **CO2:** Compare and contrast various service and deployment models.
3. **CO3:** Understand virtualization and container technologies in the cloud context.
4. **CO4:** Analyze cloud storage, computing models, and resource management.
5. **CO5:** Assess security, privacy, and compliance challenges in cloud computing.
6. **CO6:** Use basic services from cloud providers (AWS, Azure, GCP) in simple applications.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Cloud Computing Definition and characteristics of Cloud Computing, Evolution of cloud from traditional computing, Distributed computing vs. Cloud computing. Benefits, Challenges, and Risks. Cloud delivery and deployment models. Self learning topics: NIST Cloud Definition and its essential characteristics	06	CO1
2	Cloud Service Models Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS): Overview, Examples, Use cases, and Challenges. Comparison between service models. Self learning topics: Case studies of AWS, Azure, and Google Cloud	08	CO2
3	Virtualization and Resource Management Basics of Virtualization, Types of Virtualization – Full, Para, OS-level. Hypervisors: Type 1 and Type 2. Resource allocation and sharing, VM provisioning and management. Self learning topics: Docker and container-based virtualization	10	CO3
4	Cloud Deployment Models Public, Private, Hybrid, and Community Cloud – Use cases and comparative analysis. Cloud Interoperability and Standards. Service provisioning and monitoring. Self learning topics: Cloud bursting	08	CO4
5	Scalability and Resource Management Auto-scaling, Load Balancing, Elasticity in cloud, Performance metrics, and Monitoring tools. SLAs and billing models. Self learning topics: Google Kubernetes Engine (GKE)	10	CO5
6	Cloud Security and Compliance Security fundamentals: Confidentiality, Integrity, Availability. Threats and risks in cloud. Identity & Access Management (IAM), Data privacy, compliance standards (ISO, GDPR). Self learning topics: Shared Responsibility Model in AWS	10	CO6



Text Books:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill Education, ISBN: 9781259029950
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, *Distributed and Cloud Computing: From Parallel Processing to the Internet of Things*, Morgan Kaufmann, ISBN: 9780123858801
3. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, *Cloud Computing: Concepts, Technology & Architecture*, Pearson, ISBN: 9780133387520

Reference Books:

1. Gautam Shroff, *Enterprise Cloud Computing: Technology, Architecture, Applications*, Cambridge University Press, ISBN: 9781107648374
2. George Reese, *Cloud Application Architectures*, O'Reilly Media, ISBN: 9780596156367
3. Judith Hurwitz et al., *Cloud Computing for Dummies*, Wiley Publishing, ISBN: 9780470484702
4. Arshdeep Bahga, Vijay Madisetti, *Cloud Computing: A Hands-On Approach*, University Press

Web References:

1. <https://aws.amazon.com/free>
2. <https://azure.microsoft.com/en-in/free>
3. <https://cloud.google.com>
4. <https://docs.docker.com>
5. <https://www.kubernetes.io>
6. <https://www.cloudflare.com/learning/cloud-computing>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-17	Machine Learning Applications using Python	04	-	-	04	04

Prerequisites:

1. Basic knowledge of Python programming and data structures.
2. Understanding basic statistics and linear algebra.

Subject Objectives:

1. Understand the fundamentals of machine learning concepts, algorithms, and workflows.
2. Learn to implement machine learning models using Python libraries and frameworks.
3. Apply supervised and unsupervised learning methods to real-world datasets.
4. Explore feature engineering, model evaluation, and optimization techniques.
5. Develop applications integrating machine learning models into practical solutions.

Subject Outcome: Learner will be able to

1. **CO1:** Explain the basic concepts, types, and stages of the machine learning process.
2. **CO2:** Implement supervised learning algorithms using Python.
3. **CO3:** Apply unsupervised learning techniques to discover patterns in data.
4. **CO4:** Perform feature engineering, data preprocessing, and dimensionality reduction.
5. **CO5:** Evaluate, optimize, and tune machine learning models for better performance.
6. **CO6:** Develop and deploy end-to-end machine learning applications.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1: Introduction to Machine Learning and Python for ML Definition, history, applications of ML; Types of ML – Supervised, Unsupervised, Reinforcement; Python libraries for ML – NumPy, Pandas, Matplotlib, Seaborn, Scikit-learn; Jupyter Notebook environment setup. Self-learning topics: Google Colab basics.	06	CO1
2	Module2: Data Preprocessing and Feature Engineering Handling missing data, encoding categorical variables, feature scaling, normalization and standardization, outlier detection, binning, handling imbalanced datasets; Feature selection and extraction methods. Self-learning topics: Data pipelines in Scikit-learn.	09	CO4
3	Module3: Supervised Learning – Regression Models Linear Regression, Polynomial Regression, Regularization (Ridge, Lasso), Decision Trees for regression, Random Forest regression; Evaluation metrics – MAE, MSE, RMSE, R ² score. Self-learning topics: Gradient Boosting Regression.	07	CO2, CO5
4	Module4 : Supervised Learning – Classification Models Logistic Regression, k-NN, Decision Trees, Random Forest, Naïve Bayes, Support Vector Machines; Performance metrics – Accuracy, Precision, Recall, F1-Score, ROC Curve, AUC. Self-learning topics: XGBoost for classification.	07	CO2, CO5
5	Module 5: Unsupervised Learning Clustering techniques – k-Means, Hierarchical Clustering, DBSCAN; Dimensionality reduction – PCA, t-SNE; Applications in customer segmentation, anomaly detection. Self-learning topics: Association rule mining (Apriori algorithm).	06	CO3, CO4



6	Module6: Model Evaluation and Optimization Cross-validation, Hyperparameter tuning (Grid Search, Random Search, Bayesian Optimization), Bias-variance trade-off, Overfitting and underfitting. Self-learning topics: Early stopping in model training.	06	CO5
7	Module 7 : Applications and Deployment of ML Models Building end-to-end ML projects; Flask and FastAPI for deploying ML models; Introduction to ML in cloud environments (AWS, Azure, Google Cloud); Case studies in healthcare, finance, and e-commerce. Self-learning topics: Streamlit for ML application dashboards.	07	CO6

Text Books:

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 3rd Edition, O'Reilly.
2. Sebastian Raschka and Vahid Mirjalili, *Python Machine Learning*, 3rd Edition, Packt.
3. Andreas C. Müller and Sarah Guido, *Introduction to Machine Learning with Python*, O'Reilly.
4. Francois Chollet, *Deep Learning with Python*, 2nd Edition, Manning Publications.
5. Gareth James et al., *An Introduction to Statistical Learning with Applications in Python*, Springer.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning*, Springer.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press.
3. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer.
4. Yuxi (Hayden) Liu, *Python Machine Learning By Example*, Packt.
5. Pratap Dangeti, *Statistics for Machine Learning*, Packt.

Web References:

1. <https://scikit-learn.org/>
2. <https://www.tensorflow.org/>



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Elective: General

Semester - IV Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-18	Modern Web Services with REST API, ReactJS & NodeJS	04	-	-	04	04

Prerequisites:

1. Working knowledge of HTML, CSS, JavaScript
2. Basic understanding of backend programming and client-server architecture

Subject Objectives:

1. To introduce learners to RESTful web services and APIs
2. To develop dynamic frontend interfaces using ReactJS
3. To implement scalable backend services using NodeJS and ExpressJS
4. To integrate frontend and backend through API communication
5. To apply best practices in full-stack application development using modern tools

Subject Outcome: Learner will be able to

1. CO 1: Explain the architecture and principles of RESTful web services
2. CO 2: Develop backend REST APIs using NodeJS and ExpressJS
3. CO 3: Design and build dynamic user interfaces using ReactJS
4. CO 4: Connect frontend and backend using asynchronous API calls
5. CO 5: Implement data persistence using MongoDB and Mongoose
6. CO 6: Develop and deploy full-stack applications using modern toolchains



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: RESTful Web Services Introduction to Web Services; Principles of REST; HTTP Methods (GET, POST, PUT, DELETE); URI Design, Status Codes; REST vs SOAP; API Documentation (Swagger/OpenAPI); Securing REST APIs Self-learning topics: REST API versioning	06	CO1
2	Module 2: Backend Development with NodeJS and ExpressJS NodeJS Introduction, Event Loop, npm; Setting up ExpressJS Server; Routing and Middleware; Handling Requests and Responses; Error Handling; REST API Endpoints Implementation Self-learning topics: Environment variables and dotenv	09	CO2
3	Module 3: Frontend Development with ReactJS Introduction to ReactJS; Components, JSX, Props, State; Lifecycle Methods; Functional Components and Hooks (useState, useEffect); React Router; Styling and Forms in React Self-learning topics: React Context API for state management	07	CO3
4	Module 4: API Integration and Asynchronous Communication AJAX and Fetch API; Axios for HTTP Requests; Consuming REST APIs in React; Promises and Async/Await; Error Handling and Loading States; Cross-Origin Resource Sharing (CORS) Self-learning topics: Handling authentication tokens on frontend	07	CO4
5	Module 5: Data Persistence with MongoDB Introduction to NoSQL and MongoDB; CRUD Operations; Mongo Shell Basics; Mongoose ODM; Schema Design and Data Validation; Connecting NodeJS to MongoDB Self-learning topics: MongoDB Atlas and cloud setup	07	CO5



6	Module 6: Full Stack Project and Deployment Frontend-Backend Integration; Project Structure and Modularization; Build Tools (webpack, Babel basics); Deployment to Platforms (Render, Vercel, Netlify); Environment Variables and Configs Self-learning topics: CI/CD pipeline basics for full-stack deployment	09	CO6
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Text Books:

1. Ethan Brown, *Web Development with Node and Express*, O'Reilly Media, ISBN: 9781491949306
2. Alex Banks and Eve Porcello, *Learning React*, O'Reilly Media, ISBN: 9781492051725
3. Eric Bush, *Node.js Web Development*, Packt Publishing, ISBN: 9781838987572
4. Brad Dayley, *Learning MongoDB*, Addison-Wesley, ISBN: 9780134843745
5. Eric Elliott, *Programming JavaScript Applications*, O'Reilly Media, ISBN: 9781491950296

Reference Books:

1. Adam Freeman, *Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node*, Apress, ISBN: 9781484243903
2. Valentin Bojinov, *Express in Action*, Manning Publications, ISBN: 9781617292422
3. Kirupa Chinnathambi, *Learning React: A Hands-On Guide to Building Web Applications*, Addison-Wesley, ISBN: 9780134843554
4. Samer Buna, *Full-Stack React Projects*, Packt Publishing, ISBN: 9781788835537
5. Jason Hunter, *HTTP: The Definitive Guide*, O'Reilly Media, ISBN: 9781565925090

Web References:

1. <https://reactjs.org/> – Official ReactJS Documentation
2. <https://expressjs.com/> – ExpressJS Official Docs
3. <https://developer.mozilla.org/> – MDN Web Docs for JavaScript, HTTP, and APIs



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-19	Cloud Security and Risk Management	04	-	-	04	04

Prerequisites:

1. Basic knowledge of computer networks and operating systems.
2. Familiarity with cloud computing fundamentals and virtualization concepts.

Subject Objectives:

1. Introduce the concepts and principles of cloud security and its necessity in modern computing.
2. Examine cloud security architectures, models, and frameworks in various deployment scenarios.
3. Discuss identity and access management techniques in cloud environments.
4. Equip learners with skills to perform cloud-specific risk assessments and mitigation planning.
5. Analyze and apply incident response and business continuity strategies in the cloud context.

Subject Outcome: Learner will be able to

1. CO1: Explain fundamental cloud security principles, challenges, and service models.
2. CO 2: Identify and evaluate risks and vulnerabilities in cloud environments.
3. CO 3: Apply security controls, encryption methods, and compliance requirements to cloud deployments.
4. CO 4: Design identity and access management solutions for secure cloud operations.
5. CO 5: Develop incident response and disaster recovery plans for cloud-based systems.
6. CO 6: Assess emerging trends, technologies, and research in cloud security and risk management.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Cloud Security: Definitions and evolution of cloud computing; Cloud service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid, community); Shared responsibility model; Key security challenges and threat landscape; Cloud security governance. Self-learning: Case study on major cloud security breaches.	06	CO1
2	Cloud Security Architecture and Frameworks: CSA Cloud Controls Matrix (CCM); NIST Cloud Security Reference Architecture; ISO/IEC 27017 and 27018 standards; Security considerations for multi-cloud and hybrid environments; Secure cloud design principles. Self-learning: Compare NIST and CSA cloud security frameworks.	07	CO1, CO3
3	Risk Assessment in Cloud Environments: Cloud-specific risk identification; Threat modeling for cloud applications; Risk management lifecycle; Risk assessment tools and methodologies (OCTAVE, FAIR, ISO 31000); Third-party vendor risk management. Self-learning: Conduct a sample risk assessment using OCTAVE.	09	CO2
4	Identity and Access Management (IAM) in the Cloud: Authentication, authorization, and accounting (AAA); Single Sign-On (SSO); Multi-factor authentication (MFA); Role-Based Access Control (RBAC) and Attribute-Based Access Control (ABAC); Federated identity management (SAML, OAuth, OpenID Connect); Privileged Access Management (PAM). Self-learning: Implementing SSO in AWS.	08	CO4
5	Cloud Data Security and Compliance: Data classification, encryption (at rest, in transit, in use), key management, tokenization, data masking; Compliance regulations (GDPR, HIPAA, PCI-DSS, FedRAMP) and their implications for cloud systems; Cloud audit mechanisms. Self-learning: Explore AWS KMS or Azure Key Vault.	07	CO3
6	Incident Response and Business Continuity in the Cloud: Cloud-specific incident detection and response; Forensic readiness in cloud systems; Disaster recovery strategies (RPO, RTO); Backup and replication approaches; Business continuity planning for cloud workloads. Self-learning: Create a disaster recovery plan for a cloud-based web application.	08	CO5
7	Emerging Trends and Advanced Topics in Cloud Security: Zero Trust Architecture in the cloud; Confidential computing; AI/ML for threat	09	CO6



	detection; Serverless security challenges; Quantum-safe encryption for cloud; Cloud-native security tools; Current research trends and case studies. Self-learning: Research on quantum-safe cloud cryptography.		
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Text Books:

1. Krutz, R. L., & Vines, R. D., Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley.
2. Mather, T., Kumaraswamy, S., & Latif, S., Cloud Security and Privacy, O'Reilly Media.
3. Winkler, V., Securing the Cloud: Cloud Computer Security Techniques and Tactics, Syngress.
4. Rittinghouse, J. W., & Ransome, J. F., Cloud Computing: Implementation, Management, and Security, CRC Press.
5. Chou, T. S., Security Threats in Cloud Computing, CreateSpace Independent Publishing.

Reference Books:

1. Shroff, G., Enterprise Cloud Computing: Technology, Architecture, Applications, Cambridge University Press.
2. Kaufman, L. M., Data Security in the Cloud, CRC Press.
3. Jansen, W., & Grance, T., Guidelines on Security and Privacy in Public Cloud Computing, NIST Special Publication.
4. Rezaei, R., Cloud Computing: Principles and Paradigms, Wiley.
5. Erl, T., Mahmood, Z., & Puttini, R., Cloud Computing: Concepts, Technology & Architecture, Prentice Hall.

Web References:

1. <https://cloudsecurityalliance.org>
2. <https://www.nist.gov/programs-projects/nist-cloud-computing-program>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-20	Principles and Practices of Software Testing	04	-	-	04	04

Prerequisites:

1. Knowledge of programming languages and software development lifecycle
2. Understanding of basic logic and control structures
3. Familiarity with requirement analysis and design principles

Subject Objectives:

1. Understand fundamental concepts and methodologies of software testing
2. Learn various levels and types of testing
3. Apply test case design techniques and automation principles
4. Understand defect management and testing documentation
5. Gain hands-on skills in test planning, execution, and reporting

Subject Outcome: Learner will be able to

1. CO1: Explain testing objectives, strategies, and processes
2. CO2: Apply functional and structural test design techniques
3. CO3: Understand levels of testing and perform integration and system testing
4. CO4: Use tools for test automation and defect tracking
5. CO5: Design comprehensive test plans and maintain test documentation
6. CO6: Conduct effective reviews, audits, and quality assurance practices



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Software Testing Principles of testing, Software quality, SDLC vs. STLC, Role of testing in SDLC, Testing myths, Test process and policy Self learning topics: IEEE standards on testing	06	CO1
2	Test Design Techniques Black-box testing: Equivalence partitioning, Boundary value analysis, Decision table, State transition, Use case testing. White-box testing: Statement, branch, path coverage. Self learning topics: Use case testing for login modules	10	CO2
3	Levels and Types of Testing Unit testing, Integration testing (Top-down, Bottom-up), System testing, Acceptance testing. Regression, smoke, sanity, alpha-beta, and usability testing. Self learning topics: Preparing integration test cases	10	CO3
4	Automation Testing Tools Introduction to automation testing, Selenium basics, TestNG framework, Recording and running tests, Script maintenance, Assertions. Self learning topics: Writing Selenium scripts for form validation	10	CO4
5	Test Management and Defect Life Cycle Test planning, Test case documentation, Test data preparation, Defect lifecycle and classification, Bug reporting tools: JIRA, Bugzilla. Self learning topics: Using JIRA for defect logging and tracking	12	CO5
6	Quality Assurance and Reviews Software quality metrics, Quality audits, Review techniques (peer reviews, inspections), Risk-based testing, Code walkthroughs. Self learning topics: Performing checklist-based code review	12	CO6



Text Books:

1. Software Testing Principles and Practices – Srinivasan Desikan, Gopalaswamy Ramesh, Pearson, ISBN: 9788131708989
2. Foundations of Software Testing – Dorothy Graham, Erik van Veenendaal, Pearson, ISBN: 9788131724170

Reference Books:

1. Effective Software Testing – Elfriede Dustin, Addison-Wesley, ISBN: 9780321146533
2. Software Testing: A Craftsman's Approach – Paul C. Jorgensen, CRC Press, ISBN: 9780367332244
3. Selenium Testing Tools Cookbook – Unmesh Gundecha, Packt Publishing, ISBN: 9781784392514

Web References:

1. <https://www.istqb.org>
2. <https://junit.org>
3. <https://www.selenium.dev>
4. <https://www.softwaretestinghelp.com>
5. <https://www.atlassian.com/software/jira>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-21	Technical Writing and Communication for IT Professionals	02	-	-	02	02

Prerequisites:

1. Basic understanding of grammar and sentence construction
2. Familiarity with technical terms used in IT and software development
3. Interest in documentation, writing, and communication

Subject Objectives:

1. Develop technical writing skills specific to the IT domain
2. Learn effective document design and structuring for technical materials
3. Practice writing user manuals, reports, and software documentation
4. Enhance oral and written communication for professional settings
5. Understand the role of documentation in project and product development

Subject Outcome: Learner will be able to

1. CO1: Understand the principles and practices of effective technical writing
2. CO2: Apply techniques to write and organize technical documents for varied audiences
3. CO3: Create documentation such as user guides, technical reports, and white papers
4. CO4: Use documentation tools and templates used in industry
5. CO5: Communicate effectively in workplace scenarios (emails, reports, meetings)
6. CO6: Analyze and improve clarity, coherence, and usability in technical content



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Technical Writing Definition, Importance, Objectives, Characteristics of technical communication, Technical vs. Non-technical writing, Role of technical writers in IT. Self learning topics: Examples of poor vs. effective documentation	06	CO1
2	Writing Process and Document Design Planning, Drafting, Revising, Editing, Proofreading. Document formats, layout, font and style guidelines, content organization, visuals and infographics .Self learning topics: Using document style guides	10	CO2
3	Types of Technical Documents User manuals, installation guides, system documentation, release notes, white papers, case studies, API documentation, functional specs. Self learning topics: Mapping document type to user needs	10	CO3
4	Tools and Technologies for Documentation MS Word, Google Docs, Markdown, LaTeX, Snagit, Version control, Wikis, Online Help systems. Basics of content management systems .Self learning topics: Using Markdown and Git for documentation	10	CO4
5	Communication in the IT Workplace Email etiquette, Meeting notes and MoMs, Status reporting, Proposal writing, Communication in project teams, Conflict resolution techniques. Self learning topics: Common communication pitfalls in tech teams	12	CO5
6	Improving Clarity, Usability, and Accessibility Clarity and simplicity, Readability indexes, User-centered design in documentation, Language sensitivity, Accessibility standards (WCAG), Inclusive language.	12	CO6



	Self learning topics: Revising unclear technical text		
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Text Books:

1. Technical Communication – Meenakshi Raman & Sangeeta Sharma, Oxford University Press, ISBN: 9780195695747
2. A Guide to Writing as an Engineer – David Beer & David McMurrey, Wiley, ISBN: 9781118300271

Reference Books:

1. Handbook of Technical Writing – Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, Bedford/St. Martin's, ISBN: 9781457675522
2. Developing Quality Technical Information – Gretchen Hargis et al., IBM Press, ISBN: 9780131477490
3. Read Me First! A Style Guide for the Computer Industry – Sun Technical Publications, Prentice Hall, ISBN: 9780131428997

Web References:

1. <https://developers.google.com/style>
2. <https://techwhirl.com>
3. <https://www.w3.org/WAI/standards-guidelines>
4. <https://opensource.com>
5. <https://www.plainlanguage.gov>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-22	Capstone Project	08	-	-	08	08

Prerequisites:

1. Successful completion of core programming, design, and database subjects
2. Basic understanding of software project development lifecycle
3. Familiarity with at least one cloud platform or web development framework

Subject Objectives:

1. Provide hands-on experience in designing and developing a complete project
2. Integrate knowledge from multiple subjects to solve real-world problems
3. Apply SDLC principles in a practical environment
4. Foster teamwork, problem-solving, and project management skills
5. Demonstrate outcomes through presentation, report, and deployment

Subject Outcome: Learner will be able to

1. CO1: Define, design, and scope a real-time software/cloud-based project
2. CO2: Apply SDLC practices in planning, development, and testing
3. CO3: Develop and integrate functional components into a full application
4. CO4: Work effectively in teams and maintain project documentation
5. CO5: Demonstrate and deploy a working prototype or final product
6. CO6: Evaluate the effectiveness of solutions through testing and feedback



Module No.	Detailed Content	Hours	CO Mapping
1	Capstone Project Development Project identification and problem definition, requirement analysis, design and technology selection, database and API integration, implementation, testing, deployment. Includes project proposal, planning documents, mid-term demo, final report, and presentation. Self learning topics: Exploring open-source project ideas, identifying community challenges, reading GitHub repositories for inspiration	60	CO1, CO2, CO3, CO4, CO5, CO6

Text Books:

1. Software Engineering – Ian Sommerville, Pearson, ISBN: 9789332582705
2. Agile Project Management with Scrum – Ken Schwaber, Microsoft Press, ISBN: 9780735619933

Reference Books:

1. The Lean Startup – Eric Ries, ISBN: 9780307887894
2. Project Management for the Unofficial Project Manager – Kory Kogon, FranklinCovey, ISBN: 9781941631102
3. Software Project Survival Guide – Steve McConnell, Microsoft Press, ISBN: 9780735605356

Web References:

1. <https://github.com>
2. <https://www.scrum.org>
3. <https://www.atlassian.com/agile>
4. <https://opensource.guide>
5. <https://devpost.com>



Elective: Cloud Computing

Semester - III Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-16	Foundations of Cloud Computing	04	-	-	04	04

Prerequisites:

1. Basic Networking Concepts
2. Understanding of Operating Systems
3. Familiarity with Virtualization and Web Technologies

Subject Objectives:

1. Understand the fundamental concepts and architecture of cloud computing.
2. Explore various service models: IaaS, PaaS, and SaaS.
3. Learn about virtualization and containerization technologies used in cloud.
4. Examine cloud deployment models and their real-world applications.
5. Understand security, governance, and cost models in cloud environments.
6. Explore current platforms and tools: AWS, Azure, and Google Cloud basics.

Subject Outcome: Learner will be able to

1. **CO1:** Explain the core concepts and evolution of cloud computing.
2. **CO2:** Compare and contrast various service and deployment models.
3. **CO3:** Understand virtualization and container technologies in the cloud context.
4. **CO4:** Analyze cloud storage, computing models, and resource management.
5. **CO5:** Assess security, privacy, and compliance challenges in cloud computing.
6. **CO6:** Use basic services from cloud providers (AWS, Azure, GCP) in simple applications.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Cloud Computing Definition and characteristics of Cloud Computing, Evolution of cloud from traditional computing, Distributed computing vs. Cloud computing. Benefits, Challenges, and Risks. Cloud delivery and deployment models. Self learning topics: NIST Cloud Definition and its essential characteristics	06	CO1
2	Cloud Service Models Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS): Overview, Examples, Use cases, and Challenges. Comparison between service models. Self learning topics: Case studies of AWS, Azure, and Google Cloud	08	CO2
3	Virtualization and Resource Management Basics of Virtualization, Types of Virtualization – Full, Para, OS-level. Hypervisors: Type 1 and Type 2. Resource allocation and sharing, VM provisioning and management. Self learning topics: Docker and container-based virtualization	10	CO3
4	Cloud Deployment Models Public, Private, Hybrid, and Community Cloud – Use cases and comparative analysis. Cloud Interoperability and Standards. Service provisioning and monitoring. Self learning topics: Cloud bursting	08	CO4
5	Scalability and Resource Management Auto-scaling, Load Balancing, Elasticity in cloud, Performance metrics, and Monitoring tools. SLAs and billing models. Self learning topics: Google Kubernetes Engine (GKE)	10	CO5
6	Cloud Security and Compliance Security fundamentals: Confidentiality, Integrity, Availability. Threats and risks in cloud. Identity & Access Management (IAM), Data privacy, compliance standards (ISO, GDPR). Self learning topics: Shared Responsibility Model in AWS	10	CO6



Text Books:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill Education, ISBN: 9781259029950
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, *Distributed and Cloud Computing: From Parallel Processing to the Internet of Things*, Morgan Kaufmann, ISBN: 9780123858801
3. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, *Cloud Computing: Concepts, Technology & Architecture*, Pearson, ISBN: 9780133387520

Reference Books:

1. Gautam Shroff, *Enterprise Cloud Computing: Technology, Architecture, Applications*, Cambridge University Press, ISBN: 9781107648374
2. George Reese, *Cloud Application Architectures*, O'Reilly Media, ISBN: 9780596156367
3. Judith Hurwitz et al., *Cloud Computing for Dummies*, Wiley Publishing, ISBN: 9780470484702
4. Arshdeep Bahga, Vijay Madisetti, *Cloud Computing: A Hands-On Approach*, University Press

Web References:

1. <https://aws.amazon.com/free>
2. <https://azure.microsoft.com/en-in/free>
3. <https://cloud.google.com>
4. <https://docs.docker.com>
5. <https://www.kubernetes.io>
6. <https://www.cloudflare.com/learning/cloud-computing>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-23	Essentials of Amazon Web Services (AWS)	04	-	-	04	04

Prerequisites:

1. Basic knowledge of cloud computing concepts
2. Understanding of networking and virtualization
3. Familiarity with Linux command line is helpful

Subject Objectives:

1. Understand AWS architecture, core services, and use cases
2. Learn identity, compute, storage, database, and networking services in AWS
3. Gain knowledge of security, monitoring, and management tools in AWS
4. Learn to build, deploy, and manage cloud-native applications using AWS
5. Prepare learners for foundational AWS certifications

Subject Outcome: Learner will be able to

1. CO1: Understand the AWS Cloud architecture, regions, and availability zones
2. CO2: Describe and use compute services including EC2, Auto Scaling, and Elastic Load Balancing
3. CO3: Utilize AWS storage services such as S3, EBS, EFS, and Glacier
4. CO4: Configure IAM, security policies, and compliance on AWS
5. CO5: Understand AWS networking (VPC, Route Tables, Gateways, Subnets)
6. CO6: Demonstrate ability to monitor, manage, and deploy applications using AWS tools



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to AWS and Global Infrastructure Introduction to Cloud Computing, AWS Overview, AWS Global Infrastructure: Regions, Availability Zones, and Edge Locations. AWS Well-Architected Framework Basics. Self learning topics: AWS Shared Responsibility Model	06	CO1
2	Compute Services Amazon EC2: Instances, AMIs, Key Pairs, Security Groups. Elastic Load Balancing, Auto Scaling concepts. Introduction to AWS Lambda and serverless computing. Self learning topics: EC2 instance types and pricing models	10	CO2
3	Storage Services S3: Buckets, Object Storage, Permissions, Versioning, Lifecycle Policies. EBS, EFS, and Glacier. Storage classes and cost optimization strategies. Self learning topics: S3 CLI and SDK commands	10	CO3
4	Identity and Access Management (IAM) IAM Users, Groups, Roles, Policies. MFA, Access Control, Permissions Boundaries. Identity Federation, Service Control Policies. Self learning topics: IAM best practices	08	CO4
5	Networking in AWS VPC Concepts, Subnets, Internet Gateways, NAT Gateways, Route Tables, Security Groups, Network ACLs, Elastic IPs. Introduction to Direct Connect and Transit Gateway. Self learning topics: Designing a public-private VPC	10	CO5
6	Monitoring, Management and Deployment Tools CloudWatch, CloudTrail, AWS Config, Trusted Advisor. CloudFormation basics. Overview of AWS CLI, SDKs, and Elastic Beanstalk. Deployment pipeline overview. Self learning topics: Creating infrastructure with CloudFormation	10	CO6



Text Books:

1. AWS Certified Solutions Architect Official Study Guide – Joe Baron et al., Wiley, ISBN: 9781119504210
2. Amazon Web Services in Action – Michael Wittig and Andreas Wittig, Manning Publications, ISBN: 9781617295119

Reference Books:

1. Learning Amazon Web Services (AWS) – Mark Wilkins, Packt Publishing, ISBN: 9781787127632
2. Cloud Computing: Concepts, Technology & Architecture – Thomas Erl, Pearson, ISBN: 9780133387520
3. The Definitive Guide to AWS Infrastructure Automation – Bradley Campbell, Apress, ISBN: 9781484293512

Web References:

1. <https://docs.aws.amazon.com>
2. <https://aws.amazon.com/training>
3. <https://wellarchitectedlabs.com>
4. <https://github.com/aws>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-24	Microsoft Azure: Core Concepts and Services	04	-	-	04	04

Prerequisites:

1. Understanding of basic cloud computing concepts
2. Basic networking and operating systems knowledge
3. Familiarity with Microsoft environment (Windows OS, Active Directory)

Subject Objectives:

1. Understand the architecture and core components of Microsoft Azure
2. Learn about Azure resource management, subscriptions, and services
3. Use compute, storage, database, and networking services within Azure
4. Learn about security, identity, and access management in Azure
5. Gain readiness for Microsoft Certified: Azure Fundamentals (AZ-900)

Subject Outcome: Learner will be able to

1. CO1: Explain Azure architecture, subscriptions, and global infrastructure
2. CO2: Use core Azure services like VMs, App Services, and Containers
3. CO3: Work with Azure Storage, Databases, and monitoring tools
4. CO4: Configure Azure identity services using Azure AD and RBAC
5. CO5: Design and implement virtual networks and hybrid connectivity
6. CO6: Manage and secure Azure resources using built-in tools



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Microsoft Azure Overview of Microsoft Azure, Azure Regions, Resource Groups, Subscriptions, Azure Portal, Azure CLI, Azure Resource Manager (ARM). Introduction to Azure pricing and support plans. Self learning topics: Azure service-level agreements (SLAs)	06	CO1
2	Core Azure Services Azure Virtual Machines (VMs), App Services, Azure Container Instances, Azure Kubernetes Service (AKS), Azure Functions (serverless). Deployment and scaling of compute services. Self learning topics: Azure compute comparison chart	10	CO2
3	Storage and Database Services Azure Storage (Blob, File, Queue, Table), Storage Tiers, Azure SQL Database, Cosmos DB. Backup and restore strategies. Azure Monitor and Log Analytics overview. Self learning topics: Using Azure Storage Explorer	10	CO3
4	Identity and Access Management Azure Active Directory (AAD), Authentication and Authorization, Role-Based Access Control (RBAC), Identity Protection, Conditional Access, Single Sign-On (SSO). Self learning topics: User and group management in Azure AD	08	CO4
5	Networking in Azure Azure Virtual Network (VNet), Subnets, Public and Private IPs, Network Security Groups (NSGs), Azure VPN Gateway, ExpressRoute, Application Gateway, Load Balancer .Self learning topics: Designing secure VNet architectures	10	CO5
6	Monitoring, Security and Governance Azure Security Center, Azure Policy, Azure Blueprints, Azure Bastion, Key Vault, Azure Defender. Cost management and budgeting in Azure. Self learning topics: Implementing Azure governance best practices	10	CO6



Text Books:

1. Microsoft Azure Administrator Exam Ref AZ-104 – Harshul Patel, Microsoft Press, ISBN: 9780136789130
2. Microsoft Azure Essentials: Fundamentals of Azure – Michael Collier & Robin Shahan, Microsoft Press, ISBN: 9781509302963

Reference Books:

1. Learn Azure in a Month of Lunches – Iain Foulds, Manning Publications, ISBN: 9781617295294
2. Exam Ref AZ-900 Microsoft Azure Fundamentals – Jim Cheshire, Microsoft Press, ISBN: 9780136877189
3. Azure for Architects – Ritesh Modi, Packt Publishing, ISBN: 9781788397393

Web References:

1. <https://learn.microsoft.com/en-us/azure>
2. <https://azure.microsoft.com/en-us/free>
3. <https://github.com/Azure>
4. <https://docs.microsoft.com/en-us/learn/>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-25	Programming for the Cloud Environment	04	-	-	04	04

Prerequisites:

1. Strong foundation in programming (Java/Python/C#)
2. Understanding of web technologies and RESTful services
3. Familiarity with basic cloud computing concepts

Subject Objectives:

1. Develop cloud-ready applications using modern programming models
2. Use REST APIs, SDKs, and cloud-native frameworks effectively
3. Apply scalable and secure practices in cloud application development
4. Understand serverless computing and event-driven architecture
5. Deploy and monitor applications in a cloud environment

Subject Outcome: Learner will be able to

1. CO1: Develop and deploy applications using cloud SDKs and REST APIs
2. CO2: Implement storage, authentication, and messaging using cloud services
3. CO3: Build microservices and containerized applications for the cloud
4. CO4: Use serverless functions and event-driven programming paradigms
5. CO5: Apply CI/CD practices in cloud-native development
6. CO6: Monitor, debug, and secure cloud-based applications



Module No.	Detailed Content	Hours	CO Mapping
1	Cloud Application Development Essentials Characteristics of cloud applications, 12-factor app principles, SDKs and APIs for AWS, Azure, and Google Cloud. Introduction to developer tools and IDEs. Self learning topics: API authentication using tokens and secrets	06	CO1
2	Accessing Cloud Services Programmatically Using SDKs (Boto3, AWS SDK for Java, Azure SDK), calling REST APIs, integrating services like storage, database, compute. Exception handling and retries. Self learning topics: Uploading files to S3 and Blob Storage via SDK	10	CO2
3	Microservices and Containers Designing microservices, containerization using Docker, container registries, introduction to Kubernetes, service discovery, inter-service communication. Self learning topics: Dockerizing a Python/Node.js app	10	CO3
4	Serverless and Event-Driven Programming Using serverless frameworks (AWS Lambda, Azure Functions), triggers and bindings, event-driven design, state management in serverless apps. Self learning topics: Writing and deploying a Lambda function	10	CO4
5	DevOps and CI/CD in Cloud CI/CD pipeline tools (GitHub Actions, AWS CodePipeline, Azure DevOps), infrastructure as code, configuration management. Automated deployment and rollback. Self learning topics: YAML configuration for cloud workflows	12	CO5
6	Monitoring, Logging, and Security Monitoring with CloudWatch, Azure Monitor, logging with ELK stack, securing secrets and environment variables, authentication & authorization (OAuth2, IAM). Self learning topics: Centralized logging setup with ELK or Cloud-native tools	12	CO6



Text Books:

1. Cloud Native Development Patterns and Best Practices – John Gilbert, Packt Publishing, ISBN: 9781788834485
2. Programming AWS Lambda: Build and Deploy Serverless Applications – John Chapin & Mike Roberts, O'Reilly Media, ISBN: 9781492041047

Reference Books:

1. Cloud Application Architectures – George Reese, O'Reilly, ISBN: 9780596156367
2. Cloud Native Java – Josh Long, Kenny Bastani, O'Reilly, ISBN: 9781449374648
3. Hands-On Microservices with Kubernetes – Gigi Sayfan, Packt, ISBN: 9781789614383

Web References:

1. <https://docs.aws.amazon.com>
2. <https://learn.microsoft.com/en-us/azure>
3. <https://cloud.google.com/docs>
4. <https://12factor.net>
5. <https://developer.hashicorp.com>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-26	Virtualization Techniques in Cloud Computing	04	-	-	04	04

Prerequisites:

1. Understanding of Operating Systems and Computer Architecture
2. Basic knowledge of cloud computing fundamentals
3. Familiarity with server environments and networking basics

Subject Objectives:

1. Understand virtualization and its role in cloud computing
2. Compare types of virtualization and hypervisors
3. Learn VM provisioning, cloning, migration, and orchestration
4. Explore containerization and modern virtualization frameworks
5. Understand performance, resource allocation, and management in VMs

Subject Outcome: Learner will be able to

1. CO1: Define virtualization concepts and identify types of virtualization
2. CO2: Evaluate hypervisor technologies and virtual machine operations
3. CO3: Perform VM creation, cloning, snapshots, and migrations
4. CO4: Compare containers vs virtual machines in cloud environments
5. CO5: Implement resource management and monitoring for VMs
6. CO6: Work with orchestration tools and virtual infrastructure automation



Module No.	Detailed Content	Hours	CO Mapping
1	Virtualization Fundamentals Definition, History, and Need for Virtualization. Benefits and challenges. Virtualization vs. Emulation. Types of virtualization: Full, Para, OS-level. Self learning topics: Virtualization in mainframes	06	CO1
2	Hypervisors and VM Management Type 1 and Type 2 hypervisors. Examples: VMware ESXi, Hyper-V, KVM, Xen. Virtual Machine provisioning, templates, VM lifecycle, performance tuning. Self learning topics: VMware Workstation/VirtualBox hands-on setup	10	CO2
3	VM Storage and Network Virtualization Virtual Disks, Snapshots, Cloning, Thin vs Thick provisioning. Virtual Networking: Virtual switches, network adapters, virtual NICs, VLANs. Self learning topics: Hands-on with NAT and Bridged Networking	10	CO3
4	Containerization and Modern Virtualization Containers vs VMs, Docker basics, container engines, images and registries, Kubernetes overview, namespaces, pods, and orchestration. Self learning topics: Running a sample Docker container	10	CO4
5	Resource Allocation and Management CPU/Memory/Disk resource limits and shares. Overcommitment strategies. Monitoring tools (top, vmstat, vCenter). Alerts and logs. Self learning topics: Analyzing resource consumption using monitoring tools	12	CO5
6	Virtual Infrastructure Automation and Orchestration Automation using scripts, cloud-init, Ansible. Orchestration concepts. Integration with public cloud providers. VM migration techniques (live, cold). Self learning topics: Automating VM provisioning using scripts	12	CO6



Text Books:

1. Virtualization Essentials – Matthew Portnoy, Wiley, ISBN: 9781119267726
2. Mastering VMware vSphere – Nick Marshall, Wiley, ISBN: 9781119512949

Reference Books:

1. The Docker Book – James Turnbull, ISBN: 9780988825933
2. Kubernetes: Up and Running – Kelsey Hightower et al., O'Reilly, ISBN: 9781492046530
3. Operating System Concepts – Abraham Silberschatz, Wiley, ISBN: 9781119320919

Web References:

1. <https://docs.vmware.com>
2. <https://docs.microsoft.com/en-us/virtualization>
3. <https://docs.docker.com>
4. <https://kubernetes.io/docs>
5. <https://libvirt.org>



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Elective: Cloud Computing

Semester - IV Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theor y	Practical	Tutorial	Theory	Total
FY-MCA-S4-27	Google Cloud Platform: Fundamentals	04	-	-	04	04

Prerequisites:

1. Basic understanding of cloud computing
2. Familiarity with Linux operating system and networking
3. Prior exposure to programming or scripting languages is helpful

Subject Objectives:

1. Introduce the foundational concepts of Google Cloud Platform (GCP)
2. Familiarize with GCP services for compute, storage, and networking
3. Enable students to deploy and manage resources on GCP
4. Understand GCP security, billing, and monitoring tools
5. Prepare for foundational GCP certification

Subject Outcome: Learner will be able to

1. CO1: Describe GCP global infrastructure and core services
2. CO2: Use GCP's compute services such as Compute Engine and App Engine
3. CO3: Manage storage and databases in GCP
4. CO4: Design and implement virtual networks and hybrid connectivity
5. CO5: Apply identity, access management, and security features
6. CO6: Monitor resources and manage costs in GCP environment



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Google Cloud Overview of GCP, GCP regions and zones, GCP console, Cloud Shell, Marketplace. GCP resource hierarchy: Organizations, Folders, Projects, Billing. Self learning topics: GCP shared responsibility model	06	CO1
2	GCP Compute Services Compute Engine, VM instances, custom images, instance templates, App Engine, Cloud Functions. Scaling, load balancing, auto-healing. Self learning topics: Deploying a web app on App Engine	10	CO2
3	Storage and Databases in GCP Cloud Storage (Buckets, Storage Classes, Lifecycle rules), Persistent Disks, Filestore. Cloud SQL, Firestore, Bigtable. Backup and restore options. Self learning topics: Transferring files to GCP storage via gsutil	10	CO3
4	Networking in GCP VPC, Subnets, Routes, Firewalls, Cloud NAT, Load Balancer. Hybrid connectivity options: VPN, Interconnect, Peering. Self learning topics: Designing a secure VPC architecture	10	CO4
5	IAM and Security IAM roles and policies, Service Accounts, Audit Logs, Identity Aware Proxy (IAP), Cloud Key Management Service (KMS), Data Loss Prevention API. Self learning topics: Managing access via IAM	12	CO5
6	Monitoring, Logging and Billing Cloud Monitoring, Logging, Error Reporting, Trace. Billing accounts, budgets, cost management. GCP pricing calculator. Self learning topics: Setting up budget alerts in GCP	12	CO6



Text Books:

1. Google Cloud Certified Associate Cloud Engineer Study Guide – Dan Sullivan, Wiley, ISBN: 9781119618436
2. Architecting Google Cloud Solutions – Victor Dantas, Packt Publishing, ISBN: 9781800564604

Reference Books:

1. Cloud Computing with Google Cloud – Sanket Thodge, BPB Publications, ISBN: 9789389898120
2. Google Cloud Platform for Architects – Vitthal Srinivasan, Packt Publishing, ISBN: 9781789618435
3. Site Reliability Engineering – Google SRE team, O'Reilly, ISBN: 9781491929124

Web References:

1. <https://cloud.google.com/docs>
2. <https://cloud.google.com/training>
3. <https://console.cloud.google.com>
4. <https://cloud.google.com/solutions>
5. <https://cloud.google.com/architecture>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-28	IBM Cloud: Service Overview and Applications	4	-	-	4	4

Prerequisites:

1. Basic understanding of cloud computing and virtualization
2. Familiarity with REST APIs and web technologies
3. Programming experience is desirable

Subject Objectives:

1. Introduce IBM Cloud platform architecture, tools, and services
2. Learn to provision and manage compute, storage, and database services
3. Explore IBM Watson services for AI integration
4. Understand DevOps, CI/CD, and monitoring on IBM Cloud
5. Enable students to build deployable cloud-native apps using IBM Cloud

Subject Outcome: Learner will be able to

1. CO1: Describe IBM Cloud architecture and service models
2. CO2: Deploy applications using IBM Cloud Foundry and Kubernetes
3. CO3: Utilize IBM Cloud storage and data services
4. CO4: Integrate Watson AI services into cloud applications
5. CO5: Implement DevOps pipelines on IBM Cloud
6. CO6: Monitor, secure, and scale applications on IBM Cloud



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to IBM Cloud Overview of IBM Cloud architecture, regions and zones, IBM Cloud CLI, Dashboard, IAM, resource groups, service catalog. Deployment models and comparison with other cloud platforms. Self learning topics: IBM Cloud account setup and console navigation	06	CO1
2	Compute Services in IBM Cloud IBM Cloud Foundry basics, Container Registry, Kubernetes Service, Virtual Servers, serverless with IBM Cloud Functions. Self learning topics: Creating and deploying an app on IBM Cloud Foundry	10	CO2
3	Storage and Database Services IBM Cloud Object Storage, Block and File Storage, Cloud Databases: Db2, Cloudant, PostgreSQL. Storage classes and access policies. Self learning topics: Uploading data to Object Storage via CLI	10	CO3
4	IBM Watson and AI Services Introduction to Watson Assistant, Watson Natural Language Understanding (NLU), Watson Text to Speech, Visual Recognition, integration via APIs and SDKs. Self learning topics: Building a chatbot using Watson Assistant	10	CO4
5	DevOps and Automation in IBM Cloud IBM Cloud Continuous Delivery, Toolchains, Delivery Pipeline, Git integration, IBM Cloud Schematics, Infrastructure as Code (IaC). Self learning topics: Creating a pipeline for a Node.js app	12	CO5
6	Monitoring, Security, and Governance Monitoring with IBM Cloud Monitoring (based on Grafana), Activity Tracker, IAM policies, secrets management, cost management, and billing tools. Self learning topics: Setting up alerts using IBM Cloud Monitoring	12	CO6



Text Books:

1. Learning IBM Cloud – Michael Elder et al., O'Reilly Media, ISBN: 9781492076544
2. IBM Cloud Platform Primer – Rekha Kodali, McGraw Hill Education, ISBN: 9789353166862

Reference Books:

1. Cloud Computing: Concepts and Technologies – Ricardo Puttini, Thomas Erl, ISBN: 9780133387520
2. IBM Cloud Pak for Applications: IBM Redbooks, ISBN: 9780738458867
3. Hands-On AI with IBM Watson – James McCaffrey, BPB Publications, ISBN: 9789389328757

Web References:

1. <https://cloud.ibm.com/docs>
2. <https://developer.ibm.com>
3. <https://cloud.ibm.com/catalog>
4. <https://www.ibm.com/cloud/learn>
5. <https://github.com/IBM>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-20	Principles and Practices of Software Testing	04	-	-	04	04

Prerequisites:

1. Knowledge of programming languages and software development lifecycle
2. Understanding of basic logic and control structures
3. Familiarity with requirement analysis and design principles

Subject Objectives:

1. Understand fundamental concepts and methodologies of software testing
2. Learn various levels and types of testing
3. Apply test case design techniques and automation principles
4. Understand defect management and testing documentation
5. Gain hands-on skills in test planning, execution, and reporting

Subject Outcome: Learner will be able to

1. CO1: Explain testing objectives, strategies, and processes
2. CO2: Apply functional and structural test design techniques
3. CO3: Understand levels of testing and perform integration and system testing
4. CO4: Use tools for test automation and defect tracking
5. CO5: Design comprehensive test plans and maintain test documentation
6. CO6: Conduct effective reviews, audits, and quality assurance practices



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Software Testing Principles of testing, Software quality, SDLC vs. STLC, Role of testing in SDLC, Testing myths, Test process and policy .Self learning topics: IEEE standards on testing	06	CO1
2	Test Design Techniques Black-box testing: Equivalence partitioning, Boundary value analysis, Decision table, State transition, Use case testing. White-box testing: Statement, branch, path coverage. Self learning topics: Use case testing for login modules	10	CO2
3	Levels and Types of Testing Unit testing, Integration testing (Top-down, Bottom-up), System testing, Acceptance testing. Regression, smoke, sanity, alpha-beta, and usability testing. Self learning topics: Preparing integration test cases	10	CO3
4	Automation Testing Tools Introduction to automation testing, Selenium basics, TestNG framework, Recording and running tests, Script maintenance, Assertions. Self learning topics: Writing Selenium scripts for form validation	10	CO4
5	Test Management and Defect Life Cycle Test planning, Test case documentation, Test data preparation, Defect lifecycle and classification, Bug reporting tools: JIRA, Bugzilla. Self learning topics: Using JIRA for defect logging and tracking	12	CO5
6	Quality Assurance and Reviews Software quality metrics, Quality audits, Review techniques (peer reviews, inspections), Risk-based testing, Code walkthroughs. Self learning topics: Performing checklist-based code review	12	CO6



Text Books:

1. Software Testing Principles and Practices – Srinivasan Desikan, Gopalaswamy Ramesh, Pearson, ISBN: 9788131708989
2. Foundations of Software Testing – Dorothy Graham, Erik van Veenendaal, Pearson, ISBN: 9788131724170

Reference Books:

1. Effective Software Testing – Elfriede Dustin, Addison-Wesley, ISBN: 9780321146533
2. Software Testing: A Craftsman's Approach – Paul C. Jorgensen, CRC Press, ISBN: 9780367332244
3. Selenium Testing Tools Cookbook – Unmesh Gundecha, Packt Publishing, ISBN: 9781784392514

Web References:

1. <https://www.istqb.org>
2. <https://junit.org>
3. <https://www.selenium.dev>
4. <https://www.softwaretestinghelp.com>
5. <https://www.atlassian.com/software/jira>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-21	Technical Writing and Communication for IT Professionals	02	-	-	02	02

Prerequisites:

1. Basic understanding of grammar and sentence construction
2. Familiarity with technical terms used in IT and software development
3. Interest in documentation, writing, and communication

Subject Objectives:

1. Develop technical writing skills specific to the IT domain
2. Learn effective document design and structuring for technical materials
3. Practice writing user manuals, reports, and software documentation
4. Enhance oral and written communication for professional settings
5. Understand the role of documentation in project and product development

Subject Outcome: Learner will be able to

1. CO1: Understand the principles and practices of effective technical writing
2. CO2: Apply techniques to write and organize technical documents for varied audiences
3. CO3: Create documentation such as user guides, technical reports, and white papers
4. CO4: Use documentation tools and templates used in industry
5. CO5: Communicate effectively in workplace scenarios (emails, reports, meetings)
6. CO6: Analyze and improve clarity, coherence, and usability in technical content



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Technical Writing Definition, Importance, Objectives, Characteristics of technical communication, Technical vs. Non-technical writing, Role of technical writers in IT. Self learning topics: Examples of poor vs. effective documentation	06	CO1
2	Writing Process and Document Design Planning, Drafting, Revising, Editing, Proofreading. Document formats, layout, font and style guidelines, content organization, visuals and infographics .Self learning topics: Using document style guides	10	CO2
3	Types of Technical Documents User manuals, installation guides, system documentation, release notes, white papers, case studies, API documentation, functional specs. Self learning topics: Mapping document type to user needs	10	CO3
4	Tools and Technologies for Documentation MS Word, Google Docs, Markdown, LaTeX, Snagit, Version control, Wikis, Online Help systems. Basics of content management systems .Self learning topics: Using Markdown and Git for documentation	10	CO4
5	Communication in the IT Workplace Email etiquette, Meeting notes and MoMs, Status reporting, Proposal writing, Communication in project teams, Conflict resolution techniques. Self learning topics: Common communication pitfalls in tech teams	12	CO5
6	Improving Clarity, Usability, and Accessibility Clarity and simplicity, Readability indexes, User-centered design in documentation, Language sensitivity, Accessibility standards (WCAG), Inclusive language. Self learning topics: Revising unclear technical text	12	CO6



Text Books:

1. Technical Communication – Meenakshi Raman & Sangeeta Sharma, Oxford University Press, ISBN: 9780195695747
2. A Guide to Writing as an Engineer – David Beer & David McMurrey, Wiley, ISBN: 9781118300271

Reference Books:

1. Handbook of Technical Writing – Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, Bedford/St. Martin's, ISBN: 9781457675522
2. Developing Quality Technical Information – Gretchen Hargis et al., IBM Press, ISBN: 9780131477490
3. Read Me First! A Style Guide for the Computer Industry – Sun Technical Publications, Prentice Hall, ISBN: 9780131428997

Web References:

1. <https://developers.google.com/style>
2. <https://techwhirl.com>
3. <https://www.w3.org/WAI/standards-guidelines>
4. <https://opensource.com>
5. <https://www.plainlanguage.gov>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-22	Capstone Project	08	-	-	08	08

Prerequisites:

1. Successful completion of core programming, design, and database subjects
2. Basic understanding of software project development lifecycle
3. Familiarity with at least one cloud platform or web development framework

Subject Objectives:

1. Provide hands-on experience in designing and developing a complete project
2. Integrate knowledge from multiple subjects to solve real-world problems
3. Apply SDLC principles in a practical environment
4. Foster teamwork, problem-solving, and project management skills
5. Demonstrate outcomes through presentation, report, and deployment

Subject Outcome: Learner will be able to

1. CO1: Define, design, and scope a real-time software/cloud-based project
2. CO2: Apply SDLC practices in planning, development, and testing
3. CO3: Develop and integrate functional components into a full application
4. CO4: Work effectively in teams and maintain project documentation
5. CO5: Demonstrate and deploy a working prototype or final product
6. CO6: Evaluate the effectiveness of solutions through testing and feedback



Module No.	Detailed Content	Hours	CO Mapping
1	Capstone Project Development Project identification and problem definition, requirement analysis, design and technology selection, database and API integration, implementation, testing, deployment. Includes project proposal, planning documents, mid-term demo, final report, and presentation. Self learning topics: Exploring open-source project ideas, identifying community challenges, reading GitHub repositories for inspiration	60	CO1, CO2, CO3, CO4, CO5, CO6

Text Books:

1. Software Engineering – Ian Sommerville, Pearson, ISBN: 9789332582705
2. Agile Project Management with Scrum – Ken Schwaber, Microsoft Press, ISBN: 9780735619933

Reference Books:

1. The Lean Startup – Eric Ries, ISBN: 9780307887894
2. Project Management for the Unofficial Project Manager – Kory Kogon, FranklinCovey, ISBN: 9781941631102
3. Software Project Survival Guide – Steve McConnell, Microsoft Press, ISBN: 9780735605356

Web References:

1. <https://github.com>
2. <https://www.scrum.org>
3. <https://www.atlassian.com/agile>
4. <https://opensource.guide>
5. <https://devpost.com>



Elective: Full Stack Development

Semester - III Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-29	Frontend Web Development HTML, CSS & JavaScript	04	-	-	04	04

Prerequisites:

1. Basic understanding of any Object-Oriented Programming Language
2. Successfully completed Programming Concepts of Core Java Subject

Subject Objectives:

1. Understand the foundational principles of web development using HTML, CSS, and JavaScript
2. Develop web page structures with semantic HTML and apply styling using modern CSS techniques
3. Build responsive web interfaces using media queries and layout frameworks
4. Create dynamic, interactive features using JavaScript and DOM manipulation
5. Integrate all frontend technologies to develop complete, functional web applications

Subject Outcome: Learner will be able to

1. CO 1: Develop structured, accessible, and semantic webpages using HTML5
2. CO 2: Apply CSS3 styling and layout techniques including Flexbox and Grid
3. CO 3: Implement responsive web designs with media queries and frameworks
4. CO 4: Write JavaScript code using variables, control structures, functions, and arrays
5. CO 5: Manipulate the Document Object Model (DOM) and handle user events effectively
6. CO 6: Design and build interactive frontend web applications integrating HTML, CSS, and JavaScript



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: HTML5 Fundamentals HTML Introduction, Structure of HTML Document, HTML5 Semantic Tags (header, nav, section, article, footer), Forms and Input Types, Multimedia Tags (audio, video), Tables, Lists, Iframes, Hyperlinks, Accessibility Principles, ARIA Roles Self-learning topics: Meta Tags, HTML Validators	06	CO1
2	Module 2: CSS3 Styling and Layout CSS Syntax and Selectors, Box Model, Positioning and Display, Inline vs Internal vs External CSS, Backgrounds and Borders, Font Styling, Flexbox, CSS Grid, Transitions and Animations Self-learning topics: CSS Preprocessors (SCSS basics)	09	CO2
3	Module 3: Responsive Web Design Responsive Design Concepts, Viewport Meta Tag, Fluid Grids, Relative Units (em, rem, %, vh, vw), Media Queries and Breakpoints, Mobile-First Design, Bootstrap Framework Basics Self-learning topics: Accessibility in Responsive Design	07	CO3
4	Module 4: JavaScript Basics Introduction to JavaScript, Variables (var, let, const), Data Types, Operators, Conditional Statements, Loops, Functions, Arrays, Objects, Scope Self-learning topics: ES6 Features – Arrow Functions, Template Literals, Default Parameters	07	CO4
5	Module 5: DOM Manipulation and Events Understanding the DOM, DOM Tree Traversal, DOM Selectors (getElementById, querySelector, etc.), Creating and Modifying Elements, Event Handling (click, input, submit), Form Validation using JS Self-learning topics: localStorage and sessionStorage	07	CO5



6	Module 6: Capstone Project and Integration Integrating HTML, CSS, and JavaScript into a complete frontend application; Debugging with Browser Developer Tools; Performance Optimization; Accessibility Check; Final Project Submission and Evaluation Self-learning topics: Lighthouse Audits and PageSpeed Insights	09	CO6
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Text Books:

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley, ISBN: 9781118008188
2. Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, Wiley, ISBN: 9781118531648
3. Jennifer Niederst Robbins, Learning Web Design, O'Reilly, ISBN: 9781491960202
4. Thomas Powell, HTML and CSS: The Complete Reference, McGraw-Hill, ISBN: 9780071496292
5. David Sawyer McFarland, JavaScript: The Missing Manual, O'Reilly Media, ISBN: 9781491947074

Reference Books:

1. Eric A. Meyer, CSS: The Definitive Guide, O'Reilly, ISBN: 9781449393199
2. Marijn Haverbeke, Eloquent JavaScript, No Starch Press, ISBN: 9781593279509
3. David Flanagan, JavaScript: The Definitive Guide, O'Reilly Media, ISBN: 9781491952023
4. Ben Frain, Responsive Web Design with HTML5 and CSS, Packt Publishing, ISBN: 9781839211560
5. Ethan Marcotte, Responsive Web Design, A Book Apart, ISBN: 9780998314086

Web References:

1. <https://developer.mozilla.org/>
2. <https://www.w3schools.com/>
3. <https://frontendmasters.com/>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-30	Designing User Interfaces and Experiences (UI/UX)	04	-	-	04	04

Prerequisites:

1. Basic understanding of Web Technologies (HTML, CSS, JavaScript)
2. Awareness of software/system development lifecycle and basic design thinking

Subject Objectives:

1. Understand the principles of user-centered design and human-computer interaction
2. Learn the process of designing intuitive and accessible user interfaces
3. Explore tools and techniques for wireframing, prototyping, and user testing
4. Develop skills to analyze user behavior and translate requirements into design
5. Build aesthetically pleasing, responsive, and functional interfaces for web and mobile

Subject Outcome: Learner will be able to

1. CO 1: Explain key principles and elements of user interface and user experience design
2. CO 2: Analyze user requirements and develop user personas, journey maps, and use cases
3. CO 3: Apply design thinking methodology to craft effective UI/UX solutions
4. CO 4: Use industry-standard tools to create wireframes and interactive prototypes
5. CO 5: Evaluate designs through usability testing and user feedback
6. CO 6: Build responsive and accessible UI designs for web and mobile platforms



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to UI/UX Design Definition of UI and UX; Differences and Interdependencies; Importance of UI/UX in product success; Design Principles (Consistency, Feedback, Affordance, etc.); Human-Computer Interaction (HCI); Psychological Aspects of Design (Hick's Law, Fitts' Law, etc.) Self-learning topics: Real-world examples of good/bad UI/UX	06	CO1
2	Module 2: User Research and Analysis User Research Methods (Interviews, Surveys, Observation); C User Stories; Customer Journey Mapping; Task Analysis; Competitive Analysis Self-learning topics: Empathy mapping	09	CO2
3	Module 3: Design Thinking Process Overview of Design Thinking; Stages – Empathize, Define, Idea Problem Framing; Brainstorming Techniques; Ideation Worksho Self-learning topics: Double Diamond Model	07	CO3
4	Module 4: UI/UX Design Tools and Wireframing Introduction to Tools (Figma, Adobe XD, Sketch); Low-Fide Wireframes; User Flows and Information Architecture; Interactive Layouts; Typography, Color Theory, Icons Self-learning topics: Design Systems and Component Libraries	07	CO4
5	Module 5: Usability Testing and Evaluation Types of Usability Testing; A/B Testing; Heuristic Evaluation (Cognitive Walkthroughs; Collecting and Analyzing Feedback; Improvements Self-learning topics: Analytics Tools (e.g., Hotjar, Google Analytics)	07	CO5



6	Module 6: Building Responsive and Accessible Designs Responsive Design Techniques; Mobile-first Design; Accessibility (WCAG); ARIA Roles; Inclusive Design Principles; UI Implementation (Design-to-Dev) Self-learning topics: Case studies of accessibility in design	09	CO6
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Text Books:

1. Alan Cooper, Robert Reimann, *About Face: The Essentials of Interaction Design*, Wiley, ISBN: 9781118766576
2. Don Norman, *The Design of Everyday Things*, MIT Press, ISBN: 9780262525671
3. Jesse James Garrett, *The Elements of User Experience*, New Riders, ISBN: 9780321683687
4. Jeff Gothelf, *Lean UX*, O'Reilly Media, ISBN: 9781491953600
5. Rex Hartson, Pardha S. Pyla, *The UX Book: Process and Guidelines for Ensuring a Quality User Experience*, Elsevier, ISBN: 9780128053423

Reference Books:

1. Steve Krug, *Don't Make Me Think*, New Riders, ISBN: 9780321965516
2. Joel Marsh, *UX for Beginners*, O'Reilly Media, ISBN: 9781491912683
3. Ben Shneiderman, *Designing the User Interface*, Pearson, ISBN: 9780134380384
4. Jennifer Tidwell, *Designing Interfaces*, O'Reilly Media, ISBN: 9781492051961
5. Susan Weinschenk, *100 Things Every Designer Needs to Know About People*, New Riders, ISBN: 9780321767530

Web References:

1. <https://www.nngroup.com/> – Nielsen Norman Group
2. <https://material.io/> – Google Material Design Guidelines
3. <https://uxdesign.cc/> – UX Collective Blog



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-14	DevOps Foundations: Version Control & CI/CD Tools	04	-	-	04	04

Prerequisites:

1. Basic understanding of software development lifecycle
2. Familiarity with command-line tools and scripting basics

Subject Objectives:

1. To introduce the principles and practices of DevOps methodology
2. To provide hands-on knowledge of Git-based version control systems
3. To understand Continuous Integration and Continuous Delivery (CI/CD) pipelines
4. To explore DevOps tools used in automation and deployment processes
5. To equip students to work in collaborative, automated DevOps environments

Subject Outcome: Learner will be able to

1. CO 1: Understand DevOps fundamentals and its impact on the SDLC
2. CO 2: Perform source code versioning using Git and GitHub in a team-based workflow
3. CO 3: Configure and manage build automation using CI tools such as Jenkins or GitHub Actions
4. CO 4: Set up and manage containerized applications using Docker
5. CO 5: Apply basic Infrastructure-as-Code (IaC) using tools like Terraform or YAML in CI/CD pipelines
6. CO 6: Integrate DevOps tools for end-to-end software delivery and deployment



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to DevOps DevOps Overview, Principles, and Lifecycle; Benefits of DevOps Culture; Agile vs DevOps; DevOps and SDLC; Key Components: CI, CD, IaC, Monitoring; Toolchain Overview Self-learning topics: DevOps Case Studies from Industry	06	CO1
2	Module 2: Version Control with Git and GitHub Introduction to Git: Installation, Configuration, and Workflow; Git Add, Commit, Push, Pull; Branching and Merging Strategies; Git Forks, Pull Requests, Issues, Actions; Git Ignore and Git Rebase Self-learning topics: Git Hooks, Semantic Versioning	09	CO2
3	Module 3: Continuous Integration (CI) Principles of CI; Jenkins Basics and Setup; Job Configuration, Pipelines, and Builds; GitHub Actions – Workflows, Events, Jobs, Runners; CI Integration with Git Repositories; Code Coverage and Static Code Analysis Tools Self-learning topics: Environment Variables in CI Tools	07	CO3
4	Module 4: Containerization Using Docker Docker Architecture; Images and Containers; Dockerfile Creation; Image Tagging, Publishing, and Versioning; Volumes and Networking Self-learning topics: Dockerizing Full Stack Applications	07	CO4
5	Module 5: Infrastructure-as-Code and Automation IaC Concepts; YAML Basics; Introduction to Terraform and Configuration Scripts; Secrets Management; Automated Testing in Pipelines; Deployment Strategies: Blue-Green, Rolling Updates Self-learning topics: Terraform Modules and State Files	07	CO5
6	Module 6: End-to-End CI/CD Pipeline Integration Building a Complete CI/CD Pipeline; Integrating Git, Jenkins/GitHub Actions, Docker, and IaC; Notifications and Webhooks; Monitoring and Logging Basics; DevOps Security Considerations	09	CO6



	Self-learning topics: DevSecOps Overview		
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Text Books:

1. Gene Kim, Patrick Debois, John Willis, The DevOps Handbook, IT Revolution Press, ISBN: 9781942788003
2. Karl Matthias, Sean P. Kane, Docker: Up and Running, O'Reilly Media, ISBN: 9781492036739
3. Brent Laster, Jenkins 2: Up and Running, O'Reilly Media, ISBN: 9781491979594
4. Rajesh S., Getting Started with Git and GitHub, Packt Publishing, ISBN: 9781789808974
5. Mikael Krief, Learning DevOps, Packt Publishing, ISBN: 9781800562882

Reference Books:

1. Stephen Fleming, *DevOps for Developers*, Amazon Kindle Edition
2. James Turnbull, *The Docker Book*, James Turnbull Publishing, ISBN: 9780988820203
3. Yevgeniy Brikman, *Terraform: Up and Running*, O'Reilly Media, ISBN: 9781492046906
4. Chris Dawson, *Effective DevOps with AWS*, Packt Publishing, ISBN: 9781787288297
5. Kief Morris, *Infrastructure as Code*, O'Reilly Media, ISBN: 9781491924359

Web References:

1. <https://docs.github.com/> – GitHub Docs
2. <https://www.jenkins.io/doc/> – Jenkins Documentation
3. <https://docs.docker.com/> – Docker Official Docs



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-31	Principles of Software Architecture	04	-	-	04	04

Prerequisites:

1. Understanding of software development lifecycle
2. Basic knowledge of object-oriented programming principles

Subject Objectives:

1. To introduce core concepts and fundamentals of software architecture
2. To understand architectural patterns, styles, and documentation
3. To evaluate the role of quality attributes in architectural design
4. To apply software architecture principles to real-world application systems
5. To analyze and model architectures using industry-standard methods and tool

Subject Outcome: Learner will be able to

1. CO1: Explain the foundational principles and practices of software architecture
2. CO2: Identify and apply various architectural styles and patterns
3. CO3: Analyze non-functional requirements and architectural quality attributes
4. CO4: Document software architectures using UML and architecture description languages
5. CO5: Evaluate architectures using metrics, trade-offs, and decision frameworks
6. CO6: Design scalable and maintainable software architectures for modern applications



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Fundamentals of Software Architecture: Definition and Importance of Software Architecture; Software Architect vs Designer; Architectural Structures and Views; Stakeholders and Concerns; Architecture in SDLC; Architecture Business Cycle Self-learning topics: Historical evolution of software architecture	06	CO1
2	Module 2: Architectural Styles and Patterns Monolithic, Layered, Client-Server, Microservices, Event-driven, Service-Oriented Architecture (SOA); Architectural Patterns – MVC, MVVM, Broker, Pipe and Filter, Blackboard; Use cases and trade-offs Self-learning topics: Hexagonal Architecture	09	CO2
3	Module 3: Quality Attributes and Tactics: Understanding Quality Attributes – Performance, Scalability, Security, Availability, Modifiability, Usability; Attribute-driven Design (ADD); General Tactics for achieving attributes; Scenarios Self-learning topics: Availability and fault tolerance models	07	CO3
4	Module 4: Architecture Documentation and Modeling Documenting Architecture – Views, Viewpoints, and Perspectives; 4+1 View Model; UML for Architecture – Component, Deployment, Package Diagrams; Architecture Description Languages (ADLs) Self-learning topics: C4 Model for visualizing software architecture	07	CO4
5	Module5: JDBC Data Access with Spring Evaluation Techniques – ATAM, CBAM, SAAM; Trade-off Analysis; Design Decisions and Rationale; Risk Management in Architecture; Use of Metrics in Architecture Self-learning topics: Lightweight evaluation methods	07	CO5



6	Module 6: Architecting Modern Software Systems Architecture for Web-based, Cloud-native, and Distributed Systems; Scalability and Elasticity Considerations; Architecture for DevOps, CI/CD Integration; Case Studies Self-learning topics: Serverless Architecture and Edge Computing	09	CO6
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Text Books:

1. Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice, Pearson Education, ISBN: 9780136886092
2. Mark Richards, Fundamentals of Software Architecture, O'Reilly Media, ISBN: 9781492043454
3. Muhammad Ali Babar et al., Software Architecture Knowledge Management, Springer, ISBN: 9783642412456
4. Nick Rozanski & Eóin Woods, Software Systems Architecture: Working with Stakeholders Using Viewpoints and Perspectives, Addison-Wesley, ISBN: 9780321718334
5. Jason Taylor, Software Architecture for Developers, Leanpub, ISBN: 9781304992437

Reference Books:

1. Mary Shaw and David Garlan, Software Architecture: Perspectives on an Emerging Discipline, Prentice Hall, ISBN: 9780131829575
2. James O. Coplien & Douglas C. Schmidt, Pattern Languages of Program Design, Addison-Wesley, ISBN: 9780201607341
3. Eric Evans, Domain-Driven Design: Tackling Complexity in the Heart of Software, Addison-Wesley, ISBN: 978032112521
4. George Fairbanks, Just Enough Software Architecture, Marshall & Brainerd, ISBN: 9780984618101
5. Peter Eeles & Peter Cripps, The Process of Software Architecting, Addison-Wesley, ISBN: 9780321357489

Web References:

1. <https://martinfowler.com/architecture/> – Martin Fowler's Architectural Insights
2. <https://www.arc42.org/> – Architecture documentation template
3. <https://c4model.com/> – Visualizing software architecture with the C4 model



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-32	Rapid Prototyping for Web Applications	04	-	-	04	04

Prerequisites:

1. Basic knowledge of HTML, CSS, and JavaScript
2. Understanding of web development lifecycle and client-server architecture

Subject Objectives:

1. To introduce the concept and importance of rapid prototyping in web application development
2. To explore different levels of prototyping – from low-fidelity to high-fidelity
3. To build skills in using wireframing and prototyping tools for web UI/UX
4. To help learners iterate and refine web application ideas quickly and effectively
5. To develop and present functional prototypes using frontend technologies and tools

Subject Outcome: Learner will be able to

1. CO 1: Understand and explain the principles and lifecycle of rapid prototyping
2. CO 2: Create low-fidelity wireframes and mockups using sketching tools or wireframing software
3. CO 3: Design interactive high-fidelity prototypes using UI/UX tools
4. CO 4: Develop functional prototypes using frontend technologies (HTML, CSS, JavaScript)
5. CO 5: Validate and improve prototypes through user feedback and usability testing
6. CO 6: Demonstrate end-to-end prototyping of web applications using real-world scenarios



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to Rapid Prototyping Definition and Role of Prototyping in Web Development; Benefits of Rapid Prototyping; Prototyping Lifecycle and Process Models; Types of Prototypes – Throwaway, Evolutionary, Incremental; Prototyping vs Final Product Self-learning topics: Historical evolution and industry use cases	06	CO1
2	Module 2: Low-Fidelity Prototyping Paper Prototyping, Sketching Techniques; Digital Wireframing Tools (Balsamiq, Figma – low-fi mode); Use of Grids and Layouts; Content Planning and Page Structure; Defining User Flows and Navigation Self-learning topics: Comparing wireframes and mockups	09	CO2
3	Module 3: High-Fidelity Prototyping: Visual Design Principles; Interactive Prototypes using Figma/Adobe XD/Sketch; Component Libraries, Styles, Symbols; Animation and Micro-interactions; Simulating Real User Experience Self-learning topics: Responsive high-fidelity design in tools	07	CO3
4	Module 4: Functional Prototyping with Web Technologies Rapid development with HTML/CSS/JS; Reusable Components and Templates; Data Binding Basics; Simple Interactions with JS/Bootstrap; Incorporating APIs in prototypes Self-learning topics: Using frontend frameworks (React/Vue) for prototyping	07	CO4
5	Module 5: Testing and Feedback User Testing of Prototypes; Techniques – A/B Testing, Think-Aloud, Surveys; Heuristic Evaluation; Iterative Improvement; Capturing and Analyzing Feedback Self-learning topics: Analytics for prototype testing	07	CO5



6	Module 6: Capstone Prototype Project Building an End-to-End Prototype; Project Scoping; Design Presentation; Team Collaboration using Version Control (Git); Final Prototype Review and Demonstration Self-learning topics: Preparing UI Design Documentation	09	CO6
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Text Books:

1. Carolyn Snyder, *Paper Prototyping: The Fast and Easy Way to Design and Refine User Interfaces*, Morgan Kaufmann, ISBN: 9781558608702
2. Tom Greever, *Articulating Design Decisions*, O'Reilly Media, ISBN: 9781491921562
3. Travis Lowdermilk, *User-Centered Design: A Developer's Guide to Building User-Friendly Applications*, O'Reilly Media, ISBN: 9781449359805
4. Daniel Schwarz, *Practical Figma*, Packt Publishing, ISBN: 9781800564183
5. Benjamin LaGrone, *Responsive Web Design by Example*, Packt Publishing, ISBN: 9781783553078

Reference Books:

1. Scott Hurff, *Designing Products People Love*, O'Reilly Media, ISBN: 9781491923610
2. Alan Cooper et al., *About Face: The Essentials of Interaction Design*, Wiley, ISBN: 9781118766576
3. Russ Unger, Carolyn Chandler, *A Project Guide to UX Design*, New Riders, ISBN: 9780321815385
4. Jeff Gothelf, *Lean UX: Designing Great Products with Agile Teams*, O'Reilly, ISBN: 9781491953600
5. Bill Buxton, *Sketching User Experiences*, Morgan Kaufmann, ISBN: 9780123740373

Web References:

1. <https://www.figma.com/> – Figma UI/UX Design Tool
2. <https://www.smashingmagazine.com/> – UI/UX and Prototyping Articles
3. <https://uxdesign.cc/> – UX Collective



Elective: Full Stack Development

Semester – IV Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-18	Modern Web Services with REST API, ReactJS & NodeJS	04	-	-	04	04

Prerequisites:

1. Working knowledge of HTML, CSS, JavaScript
2. Basic understanding of backend programming and client-server architecture

Subject Objectives:

1. To introduce learners to RESTful web services and APIs
2. To develop dynamic frontend interfaces using ReactJS
3. To implement scalable backend services using NodeJS and ExpressJS
4. To integrate frontend and backend through API communication
5. To apply best practices in full-stack application development using modern tools

Subject Outcome: Learner will be able to

1. CO 1: Explain the architecture and principles of RESTful web services
2. CO 2: Develop backend REST APIs using NodeJS and ExpressJS
3. CO 3: Design and build dynamic user interfaces using ReactJS
4. CO 4: Connect frontend and backend using asynchronous API calls
5. CO 5: Implement data persistence using MongoDB and Mongoose
6. CO 6: Develop and deploy full-stack applications using modern toolchains



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: RESTful Web Services Introduction to Web Services; Principles of REST; HTTP Methods (GET, POST, PUT, DELETE); URI Design, Status Codes; REST vs SOAP; API Documentation (Swagger/OpenAPI); Securing REST APIs Self-learning topics: REST API versioning	06	CO1
2	Module 2: Backend Development with NodeJS and ExpressJS NodeJS Introduction, Event Loop, npm; Setting up ExpressJS Server; Routing and Middleware; Handling Requests and Responses; Error Handling; REST API Endpoints Implementation Self-learning topics: Environment variables and dotenv	09	CO2
3	Module 3: Frontend Development with ReactJS Introduction to ReactJS; Components, JSX, Props, State; Lifecycle Methods; Functional Components and Hooks (useState, useEffect); React Router; Styling and Forms in React Self-learning topics: React Context API for state management	07	CO3
4	Module 4: API Integration and Asynchronous Communication AJAX and Fetch API; Axios for HTTP Requests; Consuming REST APIs in React; Promises and Async/Await; Error Handling and Loading States; Cross-Origin Resource Sharing (CORS) Self-learning topics: Handling authentication tokens on frontend	07	CO4
5	Module 5: Data Persistence with MongoDB Introduction to NoSQL and MongoDB; CRUD Operations; Mongo Shell Basics; Mongoose ODM; Schema Design and Data Validation; Connecting NodeJS to MongoDB Self-learning topics: MongoDB Atlas and cloud setup	07	CO5



6	Module 6: Full Stack Project and Deployment Frontend-Backend Integration; Project Structure and Modularization; Build Tools (webpack, Babel basics); Deployment to Platforms (Render, Vercel, Netlify); Environment Variables and Configs Self-learning topics: CI/CD pipeline basics for full-stack deployment	09	CO6
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Text Books:

1. Ethan Brown, *Web Development with Node and Express*, O'Reilly Media, ISBN: 9781491949306
2. Alex Banks and Eve Porcello, *Learning React*, O'Reilly Media, ISBN: 9781492051725
3. Eric Bush, *Node.js Web Development*, Packt Publishing, ISBN: 9781838987572
4. Brad Dayley, *Learning MongoDB*, Addison-Wesley, ISBN: 9780134843745
5. Eric Elliott, *Programming JavaScript Applications*, O'Reilly Media, ISBN: 9781491950296

Reference Books:

1. Adam Freeman, *Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node*, Apress, ISBN: 9781484243903
2. Valentin Bojinov, *Express in Action*, Manning Publications, ISBN: 9781617292422
3. Kirupa Chinnathambi, *Learning React: A Hands-On Guide to Building Web Applications*, Addison-Wesley, ISBN: 9780134843554
4. Samer Buna, *Full-Stack React Projects*, Packt Publishing, ISBN: 9781788835537
5. Jason Hunter, *HTTP: The Definitive Guide*, O'Reilly Media, ISBN: 9781565925090

Web References:

1. <https://reactjs.org/> – Official ReactJS Documentation
2. <https://expressjs.com/> – ExpressJS Official Docs
3. <https://developer.mozilla.org/> – MDN Web Docs for JavaScript, HTTP, and APIs



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-33	Advanced DevOps: Automation and Monitoring Tools	04	-	-	04	04

Prerequisites:

1. Basic knowledge of version control, CI/CD, and shell scripting
2. Understanding of DevOps lifecycle and cloud computing fundamentals

Subject Objectives:

1. To explore advanced DevOps practices focusing on automation and monitoring
2. To implement Infrastructure as Code (IaC) using modern tools
3. To manage configuration and deployments using automated pipelines
4. To monitor and visualize system performance and application health
5. To integrate security into DevOps workflows (DevSecOps)

Subject Outcome: Learner will be able to

1. CO 1: Apply advanced concepts of DevOps and Infrastructure Automation
2. CO 2: Implement Infrastructure as Code using tools like Terraform and Ansible
3. CO 3: Configure and manage CI/CD pipelines with Jenkins and GitHub Actions
4. CO 4: Monitor system metrics and application logs using tools like Prometheus and Grafana
5. CO 5: Automate configuration and container orchestration with tools like Docker and Kubernetes
6. CO 6: Integrate security practices into DevOps workflows through DevSecOps



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Advanced DevOps and Infrastructure Automation Evolution of DevOps Automation; Infrastructure Automation Tools Overview; Push vs Pull Configuration; Immutable Infrastructure; Role of Cloud Providers in DevOps Automation Self-learning topics: Scripting for automation (Shell, Python)	06	CO1
2	Module 2: Infrastructure as Code (IaC) Concept and Benefits of IaC; Introduction to Terraform – Providers, Resources, Variables; Ansible Basics – Playbooks, Roles, Inventory; Automating Cloud Infrastructure Self-learning topics: Terraform state and modules	09	CO2
3	Module 3: CI/CD Pipeline Automation Designing and Automating Pipelines; Jenkins Pipeline as Code; GitHub Actions – Workflows, Triggers, Secrets; Environment Variables; Integrating Tests and Build Stages Self-learning topics: Notifications and deployment strategies	07	CO3
4	Module 4: Monitoring and Observability Tools System Metrics Collection (CPU, Memory, Disk); Prometheus Architecture and Query Language; Grafana Dashboards; Alerting Rules; Log Management with ELK Stack Self-learning topics: Integration with Slack/Email for alerts	07	CO4
5	Module 5: Configuration Management and Container Orchestration Advanced Docker Concepts; Docker Compose; Kubernetes Basics – Pods, Deployments, Services; Helm for Application Packaging; Ansible for Configuration Management Self-learning topics: CI/CD with Kubernetes	07	CO5
6	Module 6: DevSecOps and Final Project DevSecOps Principles; Security Scanning in CI Pipelines; OWASP Top 10; Secrets Management; Capstone Project: Design and deploy a monitored, automated, secure full-stack DevOps pipeline	09	CO6



	Self-learning topics: GitOps Overview		
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Text Books:

1. Gene Kim et al., The DevOps Handbook, IT Revolution, ISBN: 9781942788003
2. Yevgeniy Brikman, Terraform: Up and Running, O'Reilly, ISBN: 9781492046906
3. Mikael Krief, Learning DevOps, Packt Publishing, ISBN: 9781800562882
4. James Turnbull, The Art of Monitoring, James Turnbull Publishing, ISBN: 9780994103820
5. Hideto Saito et al., Kubernetes Cookbook, Packt Publishing, ISBN: 9781838828042

Reference Books:

1. Kief Morris, Infrastructure as Code, O'Reilly Media, ISBN: 9781491924359
2. John Arundel, Justin Domingus, Cloud Native DevOps with Kubernetes, O'Reilly Media, ISBN: 9781492040768
3. Julian Simpson, Jenkins: The Definitive Guide, O'Reilly Media, ISBN: 9781449305352
4. Russ McKendrick, Mastering Docker, Packt Publishing, ISBN: 9781839213403
5. Kim W., Practical Ansible, Packt Publishing, ISBN: 9781801075626

Web References:

1. <https://prometheus.io/> – Prometheus Monitoring Tool
2. <https://grafana.com/docs/> – Grafana Official Docs
3. <https://www.terraform.io/docs> – Terraform by HashiCorp



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-20	Principles and Practices of Software Testing	04	-	-	04	04

Prerequisites:

1. Knowledge of programming languages and software development lifecycle
2. Understanding of basic logic and control structures
3. Familiarity with requirement analysis and design principles

Subject Objectives:

1. Understand fundamental concepts and methodologies of software testing
2. Learn various levels and types of testing
3. Apply test case design techniques and automation principles
4. Understand defect management and testing documentation
5. Gain hands-on skills in test planning, execution, and reporting

Subject Outcome: Learner will be able to

1. CO1: Explain testing objectives, strategies, and processes
2. CO2: Apply functional and structural test design techniques
3. CO3: Understand levels of testing and perform integration and system testing
4. CO4: Use tools for test automation and defect tracking
5. CO5: Design comprehensive test plans and maintain test documentation
6. CO6: Conduct effective reviews, audits, and quality assurance practices



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Software Testing Principles of testing, Software quality, SDLC vs. STLC, Role of testing in SDLC, Testing myths, Test process and policy Self learning topics: IEEE standards on testing	06	CO1
2	Test Design Techniques Black-box testing: Equivalence partitioning, Boundary value analysis, Decision table, State transition, Use case testing. White-box testing: Statement, branch, path coverage. Self learning topics: Use case testing for login modules	10	CO2
3	Levels and Types of Testing Unit testing, Integration testing (Top-down, Bottom-up), System testing, Acceptance testing. Regression, smoke, sanity, alpha-beta, and usability testing. Self learning topics: Preparing integration test cases	10	CO3
4	Automation Testing Tools Introduction to automation testing, Selenium basics, TestNG framework, Recording and running tests, Script maintenance, Assertions. Self learning topics: Writing Selenium scripts for form validation	10	CO4
5	Test Management and Defect Life Cycle Test planning, Test case documentation, Test data preparation, Defect lifecycle and classification, Bug reporting tools: JIRA, Bugzilla. Self learning topics: Using JIRA for defect logging and tracking	12	CO5
6	Quality Assurance and Reviews Software quality metrics, Quality audits, Review techniques (peer reviews, inspections), Risk-based testing, Code walkthroughs. Self learning topics: Performing checklist-based code review	12	CO6



Text Books:

1. Software Testing Principles and Practices – Srinivasan Desikan, Gopalaswamy Ramesh, Pearson, ISBN: 9788131708989
2. Foundations of Software Testing – Dorothy Graham, Erik van Veenendaal, Pearson, ISBN: 9788131724170

Reference Books:

1. Effective Software Testing – Elfriede Dustin, Addison-Wesley, ISBN: 9780321146533
2. Software Testing: A Craftsman's Approach – Paul C. Jorgensen, CRC Press, ISBN: 9780367332244
3. Selenium Testing Tools Cookbook – Unmesh Gundecha, Packt Publishing, ISBN: 9781784392514

Web References:

1. <https://www.istqb.org>
2. <https://junit.org>
3. <https://www.selenium.dev>
4. <https://www.softwaretestinghelp.com>
5. <https://www.atlassian.com/software/jira>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-21	Technical Writing and Communication for IT Professionals	02	-	-	02	02

Prerequisites:

1. Basic understanding of grammar and sentence construction
2. Familiarity with technical terms used in IT and software development
3. Interest in documentation, writing, and communication

Subject Objectives:

1. Develop technical writing skills specific to the IT domain
2. Learn effective document design and structuring for technical materials
3. Practice writing user manuals, reports, and software documentation
4. Enhance oral and written communication for professional settings
5. Understand the role of documentation in project and product development

Subject Outcome: Learner will be able to

1. CO1: Understand the principles and practices of effective technical writing
2. CO2: Apply techniques to write and organize technical documents for varied audiences
3. CO3: Create documentation such as user guides, technical reports, and white papers
4. CO4: Use documentation tools and templates used in industry
5. CO5: Communicate effectively in workplace scenarios (emails, reports, meetings)
6. CO6: Analyze and improve clarity, coherence, and usability in technical content



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Technical Writing Definition, Importance, Objectives, Characteristics of technical communication, Technical vs. Non-technical writing, Role of technical writers in IT. Self learning topics: Examples of poor vs. effective documentation	06	CO1
2	Writing Process and Document Design Planning, Drafting, Revising, Editing, Proofreading. Document formats, layout, font and style guidelines, content organization, visuals and infographics .Self learning topics: Using document style guides	10	CO2
3	Types of Technical Documents User manuals, installation guides, system documentation, release notes, white papers, case studies, API documentation, functional specs. Self learning topics: Mapping document type to user needs	10	CO3
4	Tools and Technologies for Documentation MS Word, Google Docs, Markdown, LaTeX, Snagit, Version control, Wikis, Online Help systems. Basics of content management systems .Self learning topics: Using Markdown and Git for documentation	10	CO4
5	Communication in the IT Workplace Email etiquette, Meeting notes and MoMs, Status reporting, Proposal writing, Communication in project teams, Conflict resolution techniques. Self learning topics: Common communication pitfalls in tech teams	12	CO5
6	Improving Clarity, Usability, and Accessibility Clarity and simplicity, Readability indexes, User-centered design in documentation, Language sensitivity, Accessibility standards (WCAG), Inclusive language. Self learning topics: Revising unclear technical text	12	CO6



Text Books:

1. Technical Communication – Meenakshi Raman & Sangeeta Sharma, Oxford University Press, ISBN: 9780195695747
2. A Guide to Writing as an Engineer – David Beer & David McMurrey, Wiley, ISBN: 9781118300271

Reference Books:

1. Handbook of Technical Writing – Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, Bedford/St. Martin's, ISBN: 9781457675522
2. Developing Quality Technical Information – Gretchen Hargis et al., IBM Press, ISBN: 9780131477490
3. Read Me First! A Style Guide for the Computer Industry – Sun Technical Publications, Prentice Hall, ISBN: 9780131428997

Web References:

1. <https://developers.google.com/style>
2. <https://techwhirl.com>
3. <https://www.w3.org/WAI/standards-guidelines>
4. <https://opensource.com>
5. <https://www.plainlanguage.gov>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-22	Capstone Project	08	-	-	08	08

Prerequisites:

1. Successful completion of core programming, design, and database subjects
2. Basic understanding of software project development lifecycle
3. Familiarity with at least one cloud platform or web development framework

Subject Objectives:

1. Provide hands-on experience in designing and developing a complete project
2. Integrate knowledge from multiple subjects to solve real-world problems
3. Apply SDLC principles in a practical environment
4. Foster teamwork, problem-solving, and project management skills
5. Demonstrate outcomes through presentation, report, and deployment

Subject Outcome: Learner will be able to

1. CO1: Define, design, and scope a real-time software/cloud-based project
2. CO2: Apply SDLC practices in planning, development, and testing
3. CO3: Develop and integrate functional components into a full application
4. CO4: Work effectively in teams and maintain project documentation
5. CO5: Demonstrate and deploy a working prototype or final product
6. CO6: Evaluate the effectiveness of solutions through testing and feedback



Module No.	Detailed Content	Hours	CO Mapping
1	Capstone Project Development Project identification and problem definition, requirement analysis, design and technology selection, database and API integration, implementation, testing, deployment. Includes project proposal, planning documents, mid-term demo, final report, and presentation. Self learning topics: Exploring open-source project ideas, identifying community challenges, reading GitHub repositories for inspiration	60	CO1, CO2, CO3, CO4, CO5, CO6

Text Books:

1. Software Engineering – Ian Sommerville, Pearson, ISBN: 9789332582705
2. Agile Project Management with Scrum – Ken Schwaber, Microsoft Press, ISBN: 9780735619933

Reference Books:

1. The Lean Startup – Eric Ries, ISBN: 9780307887894
2. Project Management for the Unofficial Project Manager – Kory Kogon, FranklinCovey, ISBN: 9781941631102
3. Software Project Survival Guide – Steve McConnell, Microsoft Press, ISBN: 9780735605356

Web References:

1. <https://github.com>
2. <https://www.scrum.org>
3. <https://www.atlassian.com/agile>
4. <https://opensource.guide>
5. <https://devpost.com>



Elective: Data Analytics

Semester – III Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-13	Applied Data Analytics with Python	4	-	-	4	4

Prerequisites:

1. Basic understanding of Python programming and data handling.
2. Knowledge of statistics, probability, and basic mathematics for data analysis.

Subject Objectives:

1. To understand the principles and methods of data analytics using Python.
2. To apply Python libraries and tools for data collection, cleaning, transformation, and visualization.
3. To explore machine learning techniques for predictive and prescriptive analytics.
4. To implement end-to-end analytics workflows for business and research problems.
5. To evaluate and communicate data-driven insights effectively.

Subject Outcome: Learner will be able to

1. CO1: Perform data acquisition, cleaning, and preprocessing using Python.
2. CO2: Apply data visualization techniques using Python libraries to explore and present data.
3. CO3: Implement statistical and exploratory data analysis techniques.
4. CO4: Build and evaluate machine learning models for prediction and classification tasks.
5. CO5: Apply advanced analytics techniques such as clustering, recommendation, and time-series forecasting.
6. CO6: Develop complete data analytics projects integrating multiple stages of the workflow.
7. CO7: Interpret and present findings using best practices in data storytelling.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Data Acquisition and Preprocessing Introduction to Data Analytics; Role of Python in Data Analytics; Data types and structures in Python; Data import from CSV, Excel, SQL, APIs, Web Scraping; Handling missing data, outliers, and duplicates; Data transformation, encoding categorical variables, scaling, and normalization. Self-learning topics: Pandas I/O functions, datetime handling.	07	CO1
2	Module 2: Data Visualization with Python Principles of data visualization; Using Matplotlib and Seaborn for univariate, bivariate, and multivariate visualizations; Customizing plots; Interactive visualizations with Plotly; Visual storytelling techniques. Self-learning topics: Dashboard creation with Streamlit.	07	CO2
3	Module 3: Statistical and Exploratory Data Analysis Descriptive statistics, probability distributions, hypothesis testing; Correlation and covariance; Feature selection and dimensionality reduction (PCA). Self-learning topics: Non-parametric tests in Python.	07	CO3
4	Module 4: Machine Learning with Python Supervised learning – Regression and Classification (Linear Regression, Logistic Regression, Decision Trees, Random Forests, SVM, k-NN); Model evaluation and performance metrics; Overfitting and regularization. Self-learning topics: Cross-validation techniques.	09	CO4
5	Module 5: Advanced Analytics Techniques Unsupervised learning – Clustering (K-Means, Hierarchical); Recommendation systems (content-based, collaborative); Time series analysis and forecasting (ARIMA, Prophet). Self-learning topics: Anomaly detection in Python.	07	CO5



6	Module 6: Applied Data Analytics Project Integration of data acquisition, preprocessing, EDA, visualization, and machine learning into a complete analytics workflow; Case studies in business, social media, healthcare, and finance; Communication of insights through reports and dashboards. Self-learning topics: Best practices in model deployment.	08	CO6
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Text Books:

1. Wes McKinney, *Python for Data Analysis*, O'Reilly Media, 2nd Edition, ISBN: 9781491957660
2. Jake VanderPlas, *Python Data Science Handbook*, O'Reilly Media, ISBN: 9781491912058
3. Sebastian Raschka, *Python Machine Learning*, Packt Publishing, 3rd Edition, ISBN: 9781801819312
4. Joel Grus, *Data Science from Scratch*, O'Reilly Media, 2nd Edition, ISBN: 9781492041139
5. Allen B. Downey, *Think Stats: Exploratory Data Analysis in Python*, O'Reilly Media, ISBN: 9781491907337

Reference Books:

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly Media, 2nd Edition, ISBN: 9781492032649
2. Prateek Joshi, *Artificial Intelligence with Python*, Packt Publishing, ISBN: 9781786464392
3. Hadley Wickham & Garrett Grolemund, *R for Data Science* (for comparative study), O'Reilly Media, ISBN: 9781491910399
4. Andrea Giussani, *Data Analysis with Python and PySpark*, Packt Publishing, ISBN: 9781801072601
5. Ashish Kumar, *Mastering Python for Data Science*, Packt Publishing, ISBN: 9781783553297

Web References:

1. <https://pandas.pydata.org>
2. <https://scikit-learn.org>
3. <https://matplotlib.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-34	Data Analytics with SQL	4	-	-	4	4

Prerequisites:

1. Basic knowledge of relational database concepts and SQL fundamentals.
2. Understanding data types, table structures, and basic programming logic.

Subject Objectives:

1. To understand advanced SQL concepts for data analysis and business intelligence.
2. To perform data extraction, transformation, and aggregation using SQL.
3. To apply analytical SQL functions for data summarization and reporting.
4. To integrate SQL with analytics workflows and visualization tools.
5. To work with large datasets and optimize query performance for analytics.

Subject Outcome: Learner will be able to

1. CO1: Apply advanced SQL commands for data extraction, filtering, and aggregation.
2. CO2: Use SQL joins, subqueries, and set operations for combining and analyzing datasets.
3. CO3: Implement analytical and window functions for in-depth data analysis.
4. CO4: Design and query data warehouses for analytics purposes.
5. CO5: Integrate SQL with business intelligence tools for visualization and reporting.
6. CO6: Optimize queries and work with large-scale datasets in analytics scenarios and develop end-to-end SQL-based analytics solutions for business problems.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Advanced SQL for Data Extraction Review of SQL basics; Data filtering and sorting; Aggregate functions; Grouping and HAVING clause; Conditional expressions (CASE, IF); Pattern matching with LIKE and Regular Expressions; Data type conversions. Self-learning topics: Date and time functions in SQL.	07	CO1
2	Module 2: SQL Joins and Subqueries INNER, LEFT, RIGHT, FULL OUTER joins; CROSS join; Self-joins; Nested subqueries; Correlated subqueries; EXISTS and NOT EXISTS; Set operations (UNION, INTERSECT, EXCEPT). Self-learning topics: Common table expressions (CTE) for complex queries.	07	CO2
3	Module 3: Analytical and Window Functions Ranking functions (ROW_NUMBER, RANK, DENSE_RANK); Aggregate window functions; Running totals and moving averages; Partitioning and ordering data; LAG and LEAD functions. Self-learning topics: Using NTILE for data segmentation.	07	CO3
4	Module 4: Data Warehousing and OLAP with SQL Introduction to Data Warehousing; Star and Snowflake schema design; OLAP operations (Roll-up, Drill-down, Slice, Dice, Pivot); Materialized views. Self-learning topics: Dimensional modeling best practices.	08	CO4
5	Module 5: SQL for Business Intelligence and Visualization Connecting SQL to BI tools (Power BI, Tableau); Creating SQL-based dashboards; Generating summary reports; Using SQL for data preparation in analytics pipelines. Self-learning topics: SQL scripting for automated report generation.	07	CO5
6	Module 6: Query Optimization and Big Data SQL Indexing strategies; Query execution plans; Optimization techniques; Working with large datasets; Introduction to SQL on Big Data platforms (Hive, Spark SQL, Google BigQuery). Self-learning topics: Partitioning and sharding concepts.	09	CO6



Text Books:

1. Ben Forta, *SQL in 10 Minutes, Sams Teach Yourself*, Sams Publishing, ISBN: 9780672336072
2. Anthony Molinaro, *SQL Cookbook*, O'Reilly Media, ISBN: 9781449316944
3. Itzik Ben-Gan, *T-SQL Fundamentals*, Microsoft Press, ISBN: 9781509302000
4. Mark Reed, *SQL for Data Analytics*, Packt Publishing, ISBN: 9781800560710
5. Paulraj Ponniah, *Data Warehousing Fundamentals for IT Professionals*, Wiley, ISBN: 9780470462072

Reference Books:

1. John L. Viescas & Michael J. Hernandez, *SQL Queries for Mere Mortals*, Pearson, ISBN: 9780134858333
2. Chris Adamson & Michael Venerable, *MDX Solutions*, Wiley, ISBN: 9780471748083
3. Dan Tow, *SQL Tuning*, O'Reilly Media, ISBN: 9780596005733
4. Matt Goldwasser & Benjamin Johnston, *Learning SQL on SQL Server 2019*, Apress, ISBN: 9781484255783
5. Lahsen Abbad Andaloussi, *SQL for Data Scientists*, Wiley, ISBN: 9781119669364

Web References:

1. <https://www.sqltutorial.org>
2. <https://mode.com/sql-tutorial>
3. <https://www.postgresql.org/docs>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-35	Techniques and Tools for Web Analytics	4	-	-	4	4

Prerequisites:

1. Basic understanding of web technologies, HTML, CSS, and JavaScript.
2. Familiarity with fundamentals of digital marketing and database concepts.

Subject Objectives:

1. To understand the concepts, techniques, and tools used in web analytics.
2. To apply web analytics tools for monitoring, measuring, and improving website performance.
3. To analyze user behavior, engagement, and conversion patterns on web platforms.
4. To implement data-driven decision-making for digital marketing and business growth.
5. To integrate web analytics data with other business intelligence systems for actionable insights.

Subject Outcome: Learner will be able to

1. CO1: Explain the fundamentals, scope, and applications of web analytics.
2. CO2: Implement tracking mechanisms and collect relevant web usage data.
3. CO3: Use major web analytics tools to analyze user behavior and website performance.
4. CO4: Apply techniques for conversion rate optimization and A/B testing.
5. CO5: Integrate web analytics with SEO, SEM, and social media analytics.
6. CO6: Create and present web analytics reports for strategic decision-making.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to Web Analytics Definition and scope; Importance of web analytics in business; Types of web analytics – on-site and off-site; Key metrics and KPIs (visits, page views, bounce rate, conversion rate, CTR); Web analytics process. Self-learning topics: History and evolution of web analytics.	07	CO1
2	Data Collection and Tracking Mechanisms Tracking methods: Cookies, sessions, server logs, page tagging; Tag management systems; Event tracking; Measuring user interactions; Data privacy and ethical considerations in web analytics (GDPR, CCPA). Self-learning topics: First-party vs. third-party cookies..	07	CO2
3	Module 3: Web Analytics Tools and Platforms Google Analytics (GA4) – account setup, dashboards, traffic analysis; Adobe Analytics; Matomo; Heatmaps and session recording tools (Hotjar, Crazy Egg); Data filtering and segmentation. Self-learning topics: Setting up goals and funnels in GA4.	08	CO3
4	Module 4: Conversion Rate Optimization and A/B Testing Conversion funnel analysis; Landing page optimization; Designing and executing A/B tests; Multivariate testing; Interpreting test results and implementing improvements. Self-learning topics: Tools for A/B testing – Google Optimize, Optimizely.	07	CO4
5	Module 5: SEO, SEM, and Social Media Analytics SEO metrics – organic traffic, keyword ranking, backlink analysis; SEM metrics – impressions, CPC, quality score; Social media analytics – engagement rate, reach, sentiment analysis; Integrating data from multiple platforms. Self-learning topics: Google Search Console basics.	08	CO5



6	Module 6: Reporting and Decision-Making with Web Analytics Creating effective dashboards; Data visualization best practices; Automated reporting; Case studies of web analytics in e-commerce, media, and service industries; Translating data insights into business strategy. Self-learning topics: Data storytelling techniques for digital marketing reports.	08	CO6
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Text Books:

1. Avinash Kaushik, *Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity*, Sybex, ISBN: 9780470529393
2. Justin Cutroni, *Google Analytics*, O'Reilly Media, ISBN: 9780596158002
3. Brian Clifton, *Advanced Web Metrics with Google Analytics*, Wiley, ISBN: 9781118168448
4. Jason Burby & Shane Atchison, *Actionable Web Analytics*, Sybex, ISBN: 9780470124741
5. Judah Phillips, *Building a Digital Analytics Organization*, Pearson, ISBN: 9780133372816

Reference Books:

1. Eric T. Peterson, *Web Analytics Demystified*, Celilo Group Media, ISBN: 9780974358422
2. Feras Alhlou, Shiraz Asif, Eric Fettman, *Google Analytics Breakthrough*, Wiley, ISBN: 9781119224563
3. Steve Jackson, *Cult of Analytics: Driving Online Marketing Strategies*, Routledge, ISBN: 9780750684959
4. Clifton, Brian, *Measuring Success in Google Analytics 4*, Wiley, ISBN: 9781119798590
5. Charles L. Johnson, *Digital Marketing Analytics*, Pearson, ISBN: 9780134088365

Web References:

1. <https://analytics.google.com>
2. <https://www.adobe.com/analytics>
3. <https://matomo.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-36	Analytics for Digital and Social Media	4	-	-	4	4

Prerequisites:

1. Basic knowledge of digital marketing concepts and online advertising platforms.
2. Familiarity with data analytics fundamentals and visualization tools.

Subject Objectives:

1. To understand the fundamentals and scope of digital and social media analytics.
2. To collect, process, and analyze data from various digital and social media platforms.
3. To apply analytics for measuring campaign effectiveness and audience engagement.
4. To use tools and techniques for real-time and predictive social media insights.
5. To interpret digital analytics reports for strategic business and marketing decisions.

Subject Outcome: Learner will be able to

1. CO1: Explain the role and applications of analytics in digital and social media ecosystems.
2. CO2: Collect and process data from web, mobile, and social platforms.
3. CO3: Apply metrics and KPIs to evaluate digital marketing and social media performance.
4. CO4: Use analytics tools for campaign tracking, audience segmentation, and engagement analysis.
5. CO5: Implement predictive and sentiment analysis for social media data.
6. CO6: Design and present digital and social media analytics reports for decision-making.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to Digital and Social Media Analytics Overview of digital and social media ecosystems; Importance of analytics in marketing and branding; Digital channels and their metrics; Role of analytics in customer journey mapping; Key KPIs – impressions, CTR, engagement rate, conversion rate. Self-learning topics: Evolution of digital marketing analytics.	07	CO1
2	Module 2: Data Collection from Digital Platforms Web analytics basics; Tracking website and mobile app usage; Social media APIs (Facebook Graph API, Twitter API, LinkedIn API); Tools for data scraping; Ethical considerations and privacy regulations (GDPR, CCPA). Self-learning topics: UTM parameters for campaign tracking.	07	CO2
3	Module 3: Metrics and Performance Measurement Campaign performance metrics; Audience demographics and behavioral analytics; Funnel analysis; Attribution models (first click, last click, multi-touch); Engagement metrics for different platforms. Self-learning topics: Cohort analysis in social media campaigns.	08	CO3
4	Module 4: Tools for Digital and Social Media Analytics Google Analytics 4, Facebook Insights, Twitter Analytics, LinkedIn Analytics; Social listening tools (Hootsuite, Brandwatch, Sprout Social); Integrating analytics tools with dashboards (Google Data Studio, Power BI). Self-learning topics: Setting up goals and event tracking.	07	CO4
5	Module 5: Advanced Techniques – Sentiment and Predictive Analytics Text mining and sentiment analysis using Python and R; Topic modeling; Trend prediction; Predictive modeling for campaign success; Real-time monitoring. Self-learning topics: Using NLP for brand reputation analysis.	08	CO5
6	Module 6: Reporting and Decision-Making Designing effective analytics reports; Data storytelling for marketing teams; Case studies in e-commerce, retail, entertainment,	08	CO6



	and political campaigns; ROI measurement; Recommendations for campaign optimization. Self-learning topics: Automated report generation using APIs.		
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Text Books:

1. Marshall Sponder, Gohar F. Khan, *Digital Analytics for Marketing*, Routledge, ISBN: 9781138890708
2. Avinash Kaushik, *Web Analytics 2.0*, Sybex, ISBN: 9780470529393
3. Matthew Ganis, Avinash Kohirkar, *Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media*, IBM Press, ISBN: 9780133892949
4. Judah Phillips, *Building a Digital Analytics Organization*, Pearson, ISBN: 9780133372816
5. Shailendra Kadre, *Digital Marketing Analytics: The Ultimate Guide*, Apress, ISBN: 9781484238335

Reference Books:

1. Eric T. Peterson, *Web Analytics Demystified*, Celilo Group Media, ISBN: 9780974358422
2. Gohar F. Khan, *Creating Value with Social Media Analytics*, Springer, ISBN: 9783319733004
3. Stacey Barr, *Practical Performance Measurement*, Routledge, ISBN: 9781138186276
4. Dan Zarrella, *The Social Media Marketing Book*, O'Reilly Media, ISBN: 9780596806606
5. Brian Clifton, *Advanced Web Metrics with Google Analytics*, Wiley, ISBN: 9781118168448

Web References:

1. <https://analytics.google.com>
2. <https://sproutsocial.com>
3. <https://developers.facebook.com/docs/graph-api>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-37	Integrating IoT with Data Analytics	4	-	-	4	4

Prerequisites:

1. Basic understanding of IoT concepts, architecture, and communication protocols.
2. Knowledge of Python programming and fundamentals of data analytics.

Subject Objectives:

1. To understand the fundamentals of IoT systems, components, and communication models.
2. To acquire, process, and analyze IoT-generated data for actionable insights.
3. To apply data analytics techniques for predictive and real-time IoT applications.
4. To explore IoT data storage, cloud integration, and edge analytics approaches.
5. To design and implement end-to-end IoT analytics solutions for various domains.

Subject Outcome: Learner will be able to

1. CO1: Explain IoT architecture, components, and data flow in IoT systems.
2. CO2: Implement data acquisition and preprocessing techniques for IoT devices and sensors.
3. CO3: Apply data analytics methods for extracting insights from IoT datasets.
4. CO4: Integrate IoT data with cloud platforms and big data analytics tools.
5. CO5: Develop real-time analytics and visualization solutions for IoT applications.
6. CO6: Design complete IoT-enabled analytics systems for industrial, smart city, and healthcare use cases.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: IoT Fundamentals and Architecture Overview of IoT – definition, scope, and applications; IoT architecture layers – perception, network, and application; IoT devices, sensors, and actuators; Communication protocols (MQTT, CoAP, HTTP, LoRaWAN). Self-learning topics: Evolution of IoT and Industry 4.0.	07	CO1
2	Module 2: IoT Data Acquisition and Preprocessing Data generation in IoT systems; Data acquisition methods; Edge devices and gateways; Preprocessing techniques – cleaning, transformation, normalization; Handling streaming data from IoT devices. Self-learning topics: Time-series data in IoT.	07	CO2
3	Module 3: IoT Data Analytics Techniques Descriptive, predictive, and prescriptive analytics for IoT; Applying machine learning to IoT datasets; Anomaly detection; Predictive maintenance; Sensor fusion techniques. Self-learning topics: Case study on IoT analytics in smart agriculture.	08	CO3
4	Module 4: Cloud and Big Data Integration for IoT Analytics IoT data storage in cloud environments; Integration with AWS IoT, Azure IoT Hub, and Google Cloud IoT; Using Hadoop, Spark, and NoSQL databases for IoT data processing; Scalability and performance considerations. Self-learning topics: Data lake architecture for IoT.	08	CO4
5	Module 5: Real-Time IoT Analytics and Visualization Stream processing frameworks (Apache Kafka, Apache Flink); Real-time dashboards using Grafana and Kibana; Alerting and event-based triggers; Edge analytics concepts. Self-learning topics: Real-time analytics in industrial IoT (IIoT).	07	CO5
6	Module 6: End-to-End IoT Analytics Applications Design and implementation workflow; Case studies – smart city, healthcare monitoring, energy management; Security and privacy	08	CO6



	considerations in IoT analytics; Future trends in IoT data analytics. Self-learning topics: Federated learning for IoT.		
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Text Books:

1. Rajkumar Buyya, Amir Vahid Dastjerdi, *Internet of Things: Principles and Paradigms*, Morgan Kaufmann, ISBN: 9780128053959
2. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things: Key Applications and Protocols*, Wiley, ISBN: 9781119958352
3. Andrew Minter, *Analytics for the Internet of Things (IoT)*, Packt Publishing, ISBN: 9781785886157
4. Perry Lea, *Learning IoT Analytics*, Packt Publishing, ISBN: 9781788622998
5. Charu C. Aggarwal, *Managing and Mining Sensor Data*, Springer, ISBN: 9781461467598

Reference Books:

1. Hanes, Salgueiro, Grossetete, Barton, Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press, ISBN: 9781587144561
2. Arshdeep Bahga, Vijay Madisetti, *Internet of Things: A Hands-On Approach*, Universities Press, ISBN: 9788173719547
3. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress, ISBN: 9781484220460
4. Pethuru Raj, Anupama Raman, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, ISBN: 9781498761291
5. Srinivasan, Rajkumar, *IoT and Big Data Analytics*, Wiley, ISBN: 9781119524984

Web References:

1. <https://aws.amazon.com/iot>
2. <https://azure.microsoft.com/en-us/solutions/iot>
3. <https://iot-analytics.com>



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Elective: Data Analytics

Semester – IV Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-38	Statistical Data Analysis using R	4	-	-	4	4

Prerequisites:

1. Basic understanding of statistics, probability, and data analysis concepts.
2. Familiarity with any programming language, preferably Python or R basics.

Subject Objectives:

1. To understand the fundamentals of R programming for statistical computing.
2. To perform descriptive, inferential, and predictive statistical analysis using R.
3. To visualize data and statistical results effectively using R libraries.
4. To apply statistical modeling techniques for real-world datasets.
5. To develop end-to-end statistical data analysis workflows.

Subject Outcome: Learner will be able to

1. CO1: Use R programming for data manipulation, exploration, and visualization.
2. CO2: Apply descriptive and exploratory statistical techniques on datasets.
3. CO3: Perform probability analysis and hypothesis testing using R.
4. CO4: Build and interpret statistical models such as regression and ANOVA.
5. CO5: Implement multivariate analysis techniques for complex datasets.
6. CO6: Design complete statistical data analysis projects integrating multiple R packages.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to R for Data Analysis Overview of R and RStudio; Data types and structures in R; Data import/export; Basic R commands; Data cleaning and transformation using dplyr; Handling missing values. Self-learning topics: R Markdown for documentation.	07	CO1
2	Module 2: Descriptive and Exploratory Data Analysis Summary statistics; Measures of central tendency and dispersion; Frequency tables; Exploratory data analysis (EDA) using ggplot2 and base R plotting functions; Identifying patterns and anomalies. Self-learning topics: Creating interactive plots with plotly.	07	CO2
3	Module 3: Probability and Hypothesis Testing Probability distributions (normal, binomial, Poisson, etc.); Sampling methods; Confidence intervals; Parametric and non-parametric tests (t-test, chi-square, Mann-Whitney, Wilcoxon); p-values and statistical significance. Self-learning topics: Bootstrapping in R.	08	CO3
4	Module 4: Regression Analysis and ANOVA Simple and multiple linear regression; Logistic regression; Model diagnostics; One-way and two-way ANOVA; Post-hoc tests (Tukey's HSD). Self-learning topics: Ridge and Lasso regression in R.	08	CO4
5	Module 5: Multivariate Statistical Analysis Principal Component Analysis (PCA); Cluster analysis (hierarchical, k-means); Discriminant analysis; Factor analysis; Multidimensional scaling. Self-learning topics: Canonical correlation analysis.	07	CO5
6	Module 6: Statistical Data Analysis Project Designing complete statistical workflows; Case studies in business, healthcare, and social sciences; Model evaluation and interpretation; Report preparation and presentation. Self-learning topics: Publishing interactive dashboards using shiny.	08	CO6



Text Books:

1. Hadley Wickham, Garrett Grolemund, *R for Data Science*, O'Reilly Media, ISBN: 9781491910399
2. Norman Matloff, *The Art of R Programming*, No Starch Press, ISBN: 9781593273842
3. Peter Dalgaard, *Introductory Statistics with R*, Springer, ISBN: 9780387790534
4. Jared P. Lander, *R for Everyone: Advanced Analytics and Graphics*, Addison-Wesley, ISBN: 9780321888037
5. Robert I. Kabacoff, *R in Action*, Manning Publications, ISBN: 9781617291388

Reference Books:

1. John Verzani, *Using R for Introductory Statistics*, CRC Press, ISBN: 9781498724494
2. Michael J. Crawley, *Statistics: An Introduction Using R*, Wiley, ISBN: 9781118941096
3. Julian J. Faraway, *Linear Models with R*, CRC Press, ISBN: 9781439887332
4. Andy Field, Jeremy Miles, Zoë Field, *Discovering Statistics Using R*, SAGE Publications, ISBN: 9781446200468
5. Deborah Nolan, Duncan Temple Lang, *XML and Web Technologies for Data Sciences with R*, Springer, ISBN: 9781461479003

Web References:

1. <https://cran.r-project.org>
2. <https://ggplot2.tidyverse.org>
3. <https://shiny.rstudio.com>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-39	Data-Driven Decision Making	4	-	-	4	4

Prerequisites:

1. Basic knowledge of statistics, probability, and data analytics concepts.
2. Familiarity with data visualization tools and database querying.

Subject Objectives:

1. To understand the role of data in strategic and operational decision-making.
2. To apply statistical and analytical techniques to support business decisions.
3. To utilize visualization and reporting tools for communicating insights.
4. To evaluate decision-making processes using quantitative and qualitative data.
5. To design data-driven frameworks for solving real-world business problems.

Subject Outcome: Learner will be able to

1. CO1: Explain the concepts, process, and importance of data-driven decision-making in organizations.
2. CO2: Identify relevant data sources and perform data collection, cleaning, and preparation.
3. CO3: Apply statistical and machine learning techniques to support decision-making.
4. CO4: Develop interactive dashboards and reports for effective data communication.
5. CO5: Evaluate the impact of decisions using KPIs and performance metrics.
6. CO6: Design and present case-based data-driven decision-making solutions.



Module No.	Detailed Content	Hours	CO Mapping
1	Module 1: Introduction to Data-Driven Decision Making Definition, scope, and benefits; Types of decisions – strategic, tactical, operational; Role of data in decision-making; Decision-making models (rational, bounded rationality, data-driven); Data maturity levels in organizations. Self-learning topics: Historical evolution of decision support systems.	07	CO1
2	Module 2: Data Collection and Preparation for Decision-Making Identifying data needs; Internal and external data sources; Data cleaning, transformation, and integration; Handling missing values and outliers; Data quality assessment. Self-learning topics: Data governance frameworks.	07	CO2
3	Module 3: Analytical Techniques for Decision Support Descriptive analytics – trends, patterns, and summaries; Predictive analytics – regression, classification; Prescriptive analytics – optimization, simulation; Scenario and what-if analysis. Self-learning topics: Real-world examples of prescriptive analytics in business.	08	CO3
4	Module 4: Visualization and Reporting for Decision-Making Principles of effective visualization; Designing dashboards using Power BI, Tableau, or Google Data Studio; Storytelling with data; Automating reports; Customizing visualizations for different stakeholders. Self-learning topics: Best practices for dashboard design.	07	CO4
5	Module 5: Measuring Decision Impact Defining and selecting KPIs; Post-decision analysis; A/B testing; ROI measurement; Linking decisions to business performance. Self-learning topics: Balanced scorecard approach.	08	CO5



6	Module 6: Case Studies and Project Case studies from domains such as retail, healthcare, finance, manufacturing; Group projects implementing the end-to-end decision-making process; Ethical considerations in data-driven decisions.	08	CO6
	Self-learning topics: Emerging trends in AI-driven decision-making.		

Text Books:

1. Provost, Foster, and Tom Fawcett, *Data Science for Business*, O'Reilly Media, ISBN: 9781449361326
2. Eric Siegel, *Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die*, Wiley, ISBN: 9781119145670
3. Galit Shmueli, Peter C. Bruce, Nitin R. Patel, *Data Mining for Business Analytics*, Wiley, ISBN: 9781119549850
4. Bernard Marr, *Data-Driven Business Decision Making*, Wiley, ISBN: 9781118965835
5. Jim Sterne, *Social Media Metrics: How to Measure and Optimize Your Marketing Investment*, Wiley, ISBN: 9780470588512

Reference Books:

1. Dean Abbott, *Applied Predictive Analytics*, Wiley, ISBN: 9781118727969
2. Stephen Few, *Show Me the Numbers: Designing Tables and Graphs to Enlighten*, Analytics Press, ISBN: 9780970601973
3. Wayne L. Winston, *Microsoft Excel Data Analysis and Business Modeling*, Microsoft Press, ISBN: 9781509304219
4. Thomas H. Davenport, *Analytics at Work: Smarter Decisions, Better Results*, Harvard Business Press, ISBN: 9781422177693
5. Charles W. Kirkwood, *Decision Analysis for Business and Policy*, World Scientific, ISBN: 9789813224933

Web References:

1. <https://www.tableau.com/learn>
2. <https://powerbi.microsoft.com>
3. <https://datavizcatalogue.com>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-20	Principles and Practices of Software Testing	04	-	-	04	04

Prerequisites:

1. Knowledge of programming languages and software development lifecycle
2. Understanding of basic logic and control structures
3. Familiarity with requirement analysis and design principles

Subject Objectives:

1. Understand fundamental concepts and methodologies of software testing
2. Learn various levels and types of testing
3. Apply test case design techniques and automation principles
4. Understand defect management and testing documentation
5. Gain hands-on skills in test planning, execution, and reporting

Subject Outcome: Learner will be able to

1. CO1: Explain testing objectives, strategies, and processes
2. CO2: Apply functional and structural test design techniques
3. CO3: Understand levels of testing and perform integration and system testing
4. CO4: Use tools for test automation and defect tracking
5. CO5: Design comprehensive test plans and maintain test documentation
6. CO6: Conduct effective reviews, audits, and quality assurance practices



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Software Testing Principles of testing, Software quality, SDLC vs. STLC, Role of testing in SDLC, Testing myths, Test process and policy Self learning topics: IEEE standards on testing	06	CO1
2	Test Design Techniques Black-box testing: Equivalence partitioning, Boundary value analysis, Decision table, State transition, Use case testing. White-box testing: Statement, branch, path coverage. Self learning topics: Use case testing for login modules	10	CO2
3	Levels and Types of Testing Unit testing, Integration testing (Top-down, Bottom-up), System testing, Acceptance testing. Regression, smoke, sanity, alpha-beta, and usability testing. Self learning topics: Preparing integration test cases	10	CO3
4	Automation Testing Tools Introduction to automation testing, Selenium basics, TestNG framework, Recording and running tests, Script maintenance, Assertions. Self learning topics: Writing Selenium scripts for form validation	10	CO4
5	Test Management and Defect Life Cycle Test planning, Test case documentation, Test data preparation, Defect lifecycle and classification, Bug reporting tools: JIRA, Bugzilla. Self learning topics: Using JIRA for defect logging and tracking	12	CO5
6	Quality Assurance and Reviews Software quality metrics, Quality audits, Review techniques (peer reviews, inspections), Risk-based testing, Code walkthroughs. Self learning topics: Performing checklist-based code review	12	CO6



Text Books:

1. Software Testing Principles and Practices – Srinivasan Desikan, Gopalaswamy Ramesh, Pearson, ISBN: 9788131708989
2. Foundations of Software Testing – Dorothy Graham, Erik van Veenendaal, Pearson, ISBN: 9788131724170

Reference Books:

1. Effective Software Testing – Elfriede Dustin, Addison-Wesley, ISBN: 9780321146533
2. Software Testing: A Craftsman's Approach – Paul C. Jorgensen, CRC Press, ISBN: 9780367332244
3. Selenium Testing Tools Cookbook – Unmesh Gundecha, Packt Publishing, ISBN: 9781784392514

Web References:

1. <https://www.istqb.org>
2. <https://junit.org>
3. <https://www.selenium.dev>
4. <https://www.softwaretestinghelp.com>
5. <https://www.atlassian.com/software/jira>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-21	Technical Writing and Communication for IT Professionals	02	-	-	02	02

Prerequisites:

1. Basic understanding of grammar and sentence construction
2. Familiarity with technical terms used in IT and software development
3. Interest in documentation, writing, and communication

Subject Objectives:

1. Develop technical writing skills specific to the IT domain
2. Learn effective document design and structuring for technical materials
3. Practice writing user manuals, reports, and software documentation
4. Enhance oral and written communication for professional settings
5. Understand the role of documentation in project and product development

Subject Outcome: Learner will be able to

1. CO1: Understand the principles and practices of effective technical writing
2. CO2: Apply techniques to write and organize technical documents for varied audiences
3. CO3: Create documentation such as user guides, technical reports, and white papers
4. CO4: Use documentation tools and templates used in industry
5. CO5: Communicate effectively in workplace scenarios (emails, reports, meetings)
6. CO6: Analyze and improve clarity, coherence, and usability in technical content



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Technical Writing Definition, Importance, Objectives, Characteristics of technical communication, Technical vs. Non-technical writing, Role of technical writers in IT. Self learning topics: Examples of poor vs. effective documentation	06	CO1
2	Writing Process and Document Design Planning, Drafting, Revising, Editing, Proofreading. Document formats, layout, font and style guidelines, content organization, visuals and infographics .Self learning topics: Using document style guides	10	CO2
3	Types of Technical Documents User manuals, installation guides, system documentation, release notes, white papers, case studies, API documentation, functional specs. Self learning topics: Mapping document type to user needs	10	CO3
4	Tools and Technologies for Documentation MS Word, Google Docs, Markdown, LaTeX, Snagit, Version control, Wikis, Online Help systems. Basics of content management systems .Self learning topics: Using Markdown and Git for documentation	10	CO4
5	Communication in the IT Workplace Email etiquette, Meeting notes and MoMs, Status reporting, Proposal writing, Communication in project teams, Conflict resolution techniques. Self learning topics: Common communication pitfalls in tech teams	12	CO5
6	Improving Clarity, Usability, and Accessibility Clarity and simplicity, Readability indexes, User-centered design in documentation, Language sensitivity, Accessibility standards (WCAG), Inclusive language. Self learning topics: Revising unclear technical text	12	CO6



Text Books:

1. Technical Communication – Meenakshi Raman & Sangeeta Sharma, Oxford University Press, ISBN: 9780195695747
2. A Guide to Writing as an Engineer – David Beer & David McMurrey, Wiley, ISBN: 9781118300271

Reference Books:

1. Handbook of Technical Writing – Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, Bedford/St. Martin's, ISBN: 9781457675522
2. Developing Quality Technical Information – Gretchen Hargis et al., IBM Press, ISBN: 9780131477490
3. Read Me First! A Style Guide for the Computer Industry – Sun Technical Publications, Prentice Hall, ISBN: 9780131428997

Web References:

1. <https://developers.google.com/style>
2. <https://techwhirl.com>
3. <https://www.w3.org/WAI/standards-guidelines>
4. <https://opensource.com>
5. <https://www.plainlanguage.gov>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-22	Capstone Project	08	-	-	08	08

Prerequisites:

1. Successful completion of core programming, design, and database subjects
2. Basic understanding of software project development lifecycle
3. Familiarity with at least one cloud platform or web development framework

Subject Objectives:

1. Provide hands-on experience in designing and developing a complete project
2. Integrate knowledge from multiple subjects to solve real-world problems
3. Apply SDLC principles in a practical environment
4. Foster teamwork, problem-solving, and project management skills
5. Demonstrate outcomes through presentation, report, and deployment

Subject Outcome: Learner will be able to

1. CO1: Define, design, and scope a real-time software/cloud-based project
2. CO2: Apply SDLC practices in planning, development, and testing
3. CO3: Develop and integrate functional components into a full application
4. CO4: Work effectively in teams and maintain project documentation
5. CO5: Demonstrate and deploy a working prototype or final product
6. CO6: Evaluate the effectiveness of solutions through testing and feedback



Module No.	Detailed Content	Hours	CO Mapping
1	Capstone Project Development Project identification and problem definition, requirement analysis, design and technology selection, database and API integration, implementation, testing, deployment. Includes project proposal, planning documents, mid-term demo, final report, and presentation. Self learning topics: Exploring open-source project ideas, identifying community challenges, reading GitHub repositories for inspiration	60	CO1, CO2, CO3, CO4, CO5, CO6

Text Books:

1. Software Engineering – Ian Sommerville, Pearson, ISBN: 9789332582705
2. Agile Project Management with Scrum – Ken Schwaber, Microsoft Press, ISBN: 9780735619933

Reference Books:

1. The Lean Startup – Eric Ries, ISBN: 9780307887894
2. Project Management for the Unofficial Project Manager – Kory Kogon, FranklinCovey, ISBN: 9781941631102
3. Software Project Survival Guide – Steve McConnell, Microsoft Press, ISBN: 9780735605356

Web References:

1. <https://github.com>
2. <https://www.scrum.org>
3. <https://www.atlassian.com/agile>
4. <https://opensource.guide>
5. <https://devpost.com>



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Elective: Artificial Intelligence and Machine Learning

Semester - III

Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-17	Machine Learning Applications using Python	04	-	-	04	04

Prerequisites:

1. Basic knowledge of Python programming and data structures.
2. Understanding basic statistics and linear algebra.

Subject Objectives:

1. Understand the fundamentals of machine learning concepts, algorithms, and workflows.
2. Learn to implement machine learning models using Python libraries and frameworks.
3. Apply supervised and unsupervised learning methods to real-world datasets.
4. Explore feature engineering, model evaluation, and optimization techniques.
5. Develop applications integrating machine learning models into practical solutions.

Subject Outcome: Learner will be able to

1. **CO1:** Explain the basic concepts, types, and stages of the machine learning process.
2. **CO2:** Implement supervised learning algorithms using Python.
3. **CO3:** Apply unsupervised learning techniques to discover patterns in data.
4. **CO4:** Perform feature engineering, data preprocessing, and dimensionality reduction.
5. **CO5:** Evaluate, optimize, and tune machine learning models for better performance.
6. **CO6:** Develop and deploy end-to-end machine learning applications.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1: Introduction to Machine Learning and Python for ML Definition, history, applications of ML; Types of ML – Supervised, Unsupervised, Reinforcement; Python libraries for ML – NumPy, Pandas, Matplotlib, Seaborn, Scikit-learn; Jupyter Notebook environment setup. Self-learning topics: Google Colab basics.	06	CO1
2	Module2: Data Preprocessing and Feature Engineering Handling missing data, encoding categorical variables, feature scaling, normalization and standardization, outlier detection, binning, handling imbalanced datasets; Feature selection and extraction methods. Self-learning topics: Data pipelines in Scikit-learn.	09	CO4
3	Module3: Supervised Learning – Regression Models Linear Regression, Polynomial Regression, Regularization (Ridge, Lasso), Decision Trees for regression, Random Forest regression; Evaluation metrics – MAE, MSE, RMSE, R^2 score. Self-learning topics: Gradient Boosting Regression.	07	CO2, CO5
4	Module4 : Supervised Learning – Classification Models Logistic Regression, k-NN, Decision Trees, Random Forest, Naïve Bayes, Support Vector Machines; Performance metrics – Accuracy, Precision, Recall, F1-Score, ROC Curve, AUC. Self-learning topics: XGBoost for classification.	07	CO2, CO5
5	Module 5: Unsupervised Learning Clustering techniques – k-Means, Hierarchical Clustering, DBSCAN; Dimensionality reduction – PCA, t-SNE; Applications in customer segmentation, anomaly detection. Self-learning topics: Association rule mining (Apriori algorithm).	06	CO3, CO4



6	Module6: Model Evaluation and Optimization Cross-validation, Hyperparameter tuning (Grid Search, Random Search, Bayesian Optimization), Bias-variance trade-off, Overfitting and underfitting. Self-learning topics: Early stopping in model training.	06	CO5
7	Module 7 : Applications and Deployment of ML Models Building end-to-end ML projects; Flask and FastAPI for deploying ML models; Introduction to ML in cloud environments (AWS, Azure, Google Cloud); Case studies in healthcare, finance, and e-commerce. Self-learning topics: Streamlit for ML application dashboards.	07	CO6

Text Books:

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 3rd Edition, O'Reilly.
2. Sebastian Raschka and Vahid Mirjalili, *Python Machine Learning*, 3rd Edition, Packt.
3. Andreas C. Müller and Sarah Guido, *Introduction to Machine Learning with Python*, O'Reilly.
4. Francois Chollet, *Deep Learning with Python*, 2nd Edition, Manning Publications.
5. Gareth James et al., *An Introduction to Statistical Learning with Applications in Python*, Springer.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning*, Springer.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press.
3. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer.
4. Yuxi (Hayden) Liu, *Python Machine Learning By Example*, Packt.
5. Pratap Dangeti, *Statistics for Machine Learning*, Packt.

Web References:

1. <https://scikit-learn.org/>
2. <https://www.tensorflow.org/>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-40	Statistical Foundations for Machine Learning with Python	04	-	-	04	04

Prerequisites:

1. Basic understanding of Python programming and data structures.
2. Knowledge of basic linear algebra and calculus fundamentals.

Subject Objectives:

1. Introduce the fundamentals of probability and statistical inference for machine learning.
2. Teach data exploration, visualization, and preparation techniques using Python.
3. Demonstrate hypothesis testing and regression analysis for predictive modeling.
4. Integrate statistical methods into machine learning workflows.
5. Enable students to apply advanced statistical concepts to real-world problems using Python.

Subject Outcome: Learner will be able to

1. CO1 Apply probability distributions and statistical measures to model datasets.
2. CO2: Perform exploratory data analysis and visualization using Python.
3. CO3: Conduct hypothesis testing and interpret statistical significance.
4. CO4: Build and evaluate regression and classification models using statistical methods.
5. CO5: Apply dimensionality reduction and feature selection techniques.
6. CO6: Integrate statistical modeling within machine learning pipelines.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1 Introduction to Statistical Foundations for Machine Learning Role of statistics in ML, Overview of Python for statistical computing (NumPy, pandas, Matplotlib, seaborn). Types of data, Scales of measurement, Measures of central tendency, dispersion, and shape. Self-learning topic: Python setup for data science.	06	CO1
2	Module2 Probability Theory and Distributions Basic probability rules, Conditional probability, Bayes' theorem, Random variables. Discrete distributions (Binomial, Poisson, Geometric). Continuous distributions (Normal, Exponential, Uniform). Python implementation and visualization of distributions. Self-learning topic: Central Limit Theorem in Python.	09	CO4
3	Module3: Exploratory Data Analysis (EDA): Data summarization, handling missing data, outlier detection. Visualization techniques: histograms, boxplots, scatterplots, pairplots. Correlation analysis, heatmaps, Python packages for EDA. Self-learning topic: Advanced visualization using Plotly.	07	CO2
4	Module4 : Statistical Inference and Hypothesis Testing Population vs. sample, Sampling techniques, Estimation (point and interval), Confidence intervals. Hypothesis formulation, t-tests, Chi-square tests, ANOVA. p-values and statistical significance. Python-based hypothesis testing examples. Self-learning topic: Bootstrap methods.	08	CO3
5	Module 5: Regression and Classification Fundamentals Simple and multiple linear regression, logistic regression. Model assumptions and diagnostics, multicollinearity. Evaluating model performance (R^2 , Adjusted R^2 , AIC, BIC, Confusion matrix, ROC curves). Python implementation using statsmodels and scikit-learn. Self-learning topic: Polynomial regression.	09	CO4



6	Module6: Dimensionality Reduction and Feature Selection Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), feature importance measures. Regularization techniques (Ridge, Lasso). Python implementations and interpretation. Self-learning topic: t-SNE for visualization.	07	CO5
7	Module 7 : Integrating Statistics into Machine Learning Pipelines Preprocessing data, statistical feature engineering, cross-validation, bias-variance tradeoff. Case studies combining statistical methods with ML algorithms. End-to-end project in Python. Self-learning topic: Time-series forecasting basics.	08	CO6

Text Books:

1. Montgomery, D.C., & Runger, G.C. *Applied Statistics and Probability for Engineers*, Wiley.
2. Freedman, D., Pisani, R., & Purves, R. *Statistics*, W.W. Norton & Company.
3. Raschka, S., & Mirjalili, V. *Python Machine Learning*, Packt Publishing.
4. McKinney, W. *Python for Data Analysis*, O'Reilly Media.
5. Downey, A. *Think Stats: Probability and Statistics for Programmers*, O'Reilly Media.

Reference Books:

1. Hastie, T., Tibshirani, R., & Friedman, J. *The Elements of Statistical Learning*, Springer.
2. James, G., Witten, D., Hastie, T., & Tibshirani, R. *An Introduction to Statistical Learning*, Springer.
3. Bishop, C.M. *Pattern Recognition and Machine Learning*, Springer.
4. Gelman, A., et al. *Bayesian Data Analysis*, CRC Press.
5. Field, A. *Discovering Statistics Using SPSS and Python*, Sage.

Web References:

1. <https://scikit-learn.org>
2. <https://numpy.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-41	Machine Learning for Business Intelligence	04	-	-	04	04

Prerequisites:

1. Basic knowledge of statistics and probability
2. Understanding of Python programming and basic data analysis libraries (NumPy, Pandas, Matplotlib)

Subject Objectives:

1. Understand the fundamental concepts of machine learning and their role in business intelligence.
2. Apply supervised and unsupervised learning techniques to solve business problems.
3. Analyze and preprocess business datasets for predictive modeling.
4. Implement and evaluate machine learning models for decision-making.
5. Integrate machine learning models into business intelligence workflows.

Subject Outcome: Learner will be able to

1. **CO1:** Explain key machine learning concepts and their applications in business intelligence.
2. **CO2:** Preprocess and transform business datasets for analysis and modeling.
3. **CO3:** Implement supervised learning algorithms for predictive analytics.
4. **CO4:** Apply unsupervised learning techniques for customer segmentation and pattern discovery..
5. **CO5:** Evaluate and interpret the performance of machine learning models in business contexts.
6. **CO6:** Deploy machine learning models and integrate them into BI dashboards and decision-support systems.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1 Introduction to Machine Learning and Business Intelligence Overview of ML, AI, and BI; Data-driven decision making; Role of ML in BI; Types of data (structured, unstructured, semi-structured); Data sources in business; Self-learning topics: History of ML in business analytics.	06	CO1
2	Module2 Data Preprocessing and Feature Engineering for BI Data cleaning, handling missing values, outlier detection; Feature scaling and encoding; Feature selection methods; Data transformation techniques; Self-learning topics: Data wrangling with Python (Pandas).	07	CO2
3	Module3: Supervised Learning for Business Applications Linear regression, logistic regression, decision trees, random forests, gradient boosting; Case studies in sales forecasting, churn prediction, and risk assessment; Model evaluation metrics (accuracy, precision, recall, F1 score, ROC-AUC); Self-learning topics: Regularization methods.	09	CO3
4	Module4 Unsupervised Learning in Business Intelligence Clustering methods (K-means, hierarchical clustering, DBSCAN); Dimensionality reduction (PCA, t-SNE); Market basket analysis and association rule mining; Applications in customer segmentation and product recommendation; Self-learning topics: Advanced clustering algorithms.	08	CO4
5	Module 5 Advanced Topics: Deep Learning and Natural Language Processing in BI Neural networks for tabular and text data; Word embeddings; Sentiment analysis for customer feedback; Text classification and topic modeling for business insights; Self-learning topics: Transformer-based models for BI.	07	CO5



6	Module6: Model Deployment and Integration with BI Tools Model serving (Flask, FastAPI); Connecting ML models with BI tools like Power BI and Tableau; Real-time analytics and dashboards; Model monitoring and maintenance; Self-learning topics: MLOps in business environments.	07	CO6
7	Module 7 : Case Studies and Capstone Project End-to-end ML-BI workflow; Industry case studies in finance, marketing, operations; Capstone project integrating ML model into a BI dashboard; Self-learning topics: Ethical considerations in ML for BI.	06	CO1, CO2, CO3, CO4, CO5, CO6

Text Books:

1. James, G., Witten, D., Hastie, T., & Tibshirani, R. *An Introduction to Statistical Learning with Applications in R and Python*. Springer.
2. Géron, A. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*. O'Reilly Media.
3. Han, J., Kamber, M., & Pei, J. *Data Mining: Concepts and Techniques*. Morgan Kaufmann.
4. Provost, F., & Fawcett, T. *Data Science for Business*. O'Reilly Media.
5. Sharda, R., Delen, D., & Turban, E. *Business Intelligence, Analytics, and Data Science: A Managerial Perspective*. Pearson.

Reference Books:

1. Aggarwal, C. C. *Machine Learning for Text*. Springer.
2. Kuhn, M., & Johnson, K. *Applied Predictive Modeling*. Springer.
3. Goodfellow, I., Bengio, Y., & Courville, A. *Deep Learning*. MIT Press.
4. Dean, J. *Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners*. Wiley.
5. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. J. *Data Mining: Practical Machine Learning Tools and Techniques*. Morgan Kaufmann.

Web References:

1. <https://scikit-learn.org>
2. <https://towardsdatascience.com>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-42	Deep Learning and Natural Language Processing (NLP)	04	-	-	04	04

Prerequisites:

1. Basic understanding of Machine Learning concepts and Python programming.
2. Successfully completed a Subject in Probability, Statistics, and Linear Algebra.

Subject Objectives:

1. Understand the fundamentals of deep learning architectures and optimization techniques.
2. Explore core concepts of Natural Language Processing, including text representation and language models.
3. Implement deep learning algorithms for various NLP tasks.
4. Integrate deep learning techniques with NLP pipelines for real-world applications.
5. Evaluate and fine-tune deep learning-based NLP models for performance improvement.

Subject Outcome: Learner will be able to

1. CO1 Explain deep learning fundamentals, architectures, and training mechanisms.
2. CO2: Apply various word and document representation techniques in NLP tasks.
3. CO3: Design and implement recurrent and transformer-based neural networks for NLP.
4. CO4: Build NLP systems for tasks such as text classification, sentiment analysis, and machine translation.
5. CO5: Integrate pre-trained models and fine-tune them for domain-specific applications.
6. CO6: Evaluate NLP models using standard metrics and improve performance with optimization strategies.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1 Introduction to Deep Learning and NLP: Overview of AI, ML, and DL; Neural networks basics; Activation functions; Gradient descent and backpropagation; Introduction to NLP and its applications; Text preprocessing (tokenization, stemming, lemmatization, stopword removal). Self-learning topics: History of NLP and DL milestones.	06	CO1
2	Module2 Word and Document Representation: One-hot encoding; Word embeddings (Word2Vec, GloVe, FastText); Contextual embeddings (ELMo, BERT embeddings); Document embeddings; Subword and character embeddings. Self-learning topics: Byte Pair Encoding (BPE).	07	CO2
3	Module3: Recurrent Neural Networks for NLP RNN, LSTM, GRU architectures; Sequence-to-sequence models; Attention mechanisms; Encoder-decoder frameworks. Self-learning topics: Bi-directional RNNs.	07	CO3
4	Module4 : Transformers and Modern NLP Architectures Transformer architecture; Self-attention and multi-head attention; Positional encoding; BERT, GPT, RoBERTa, T5. Self-learning topics: Vision Transformers for text-based tasks.	07	CO3,CO4
5	Module 5: Deep Learning for NLP Tasks Text classification, sentiment analysis, named entity recognition (NER), machine translation, text summarization, question answering. Self-learning topics: Topic modeling with neural approaches.	06	CO4
6	Module 6: Pre-trained Language Models and Fine-tuning Transfer learning in NLP; Pre-training vs. fine-tuning; Domain adaptation; Prompt engineering; Zero-shot and few-shot learning. Self-learning topics: Low-rank adaptation (LoRA) in NLP.	06	CO5
7	Module 7 : Evaluation and Optimization in NLP Evaluation metrics (BLEU, ROUGE, perplexity, F1-score); Hyperparameter tuning; Regularization techniques; Model compression; Deployment considerations for NLP models. Self-	06	CO6



	learning topics: Interpretability in NLP models.		
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Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.
2. Palash Goyal, Sumit Pandey, Karan Jain, Deep Learning for Natural Language Processing, Apress.
3. Daniel Jurafsky, James H. Martin, Speech and Language Processing, Pearson.
4. Dipanjan Sarkar, Text Analytics with Python, Apress.
5. Lewis Tunstall, Leandro von Werra, Thomas Wolf, Natural Language Processing with Transformers, O'Reilly.

Reference Books:

1. Jacob Eisenstein, Natural Language Processing, MIT Press.
2. Delip Rao, Brian McMahan, Natural Language Processing with PyTorch, O'Reilly.
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer.
4. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, O'Reilly.
5. Thomas Mikolov et al., Efficient Estimation of Word Representations in Vector Space, arXiv.

Web References:

1. <https://nlp.stanford.edu/>
2. <https://huggingface.co/docs>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-43	Web and Social Media Analytics with Data Visualization	04	-	-	04	04

Prerequisites:

1. Basic understanding of data analytics and statistics.
2. Familiarity with at least one programming language (Python or R preferred).

Subject Objectives:

1. Understand the principles and techniques of web analytics and social media data analytics.
2. Learn to extract, clean, and preprocess data from various online platforms and APIs.
3. Apply analytical methods to measure online engagement, sentiment, and user behavior.
4. Develop data visualization dashboards to present analytical insights effectively.
5. Integrate analytics tools to support decision-making in digital marketing and communication strategies.

Subject Outcome: Learner will be able to

1. CO1 Explain the fundamentals of web and social media analytics and their business applications.
2. CO2: Extract process, and analyze data from web and social media platforms using suitable tools.
3. CO3: Apply sentiment analysis and engagement metrics to evaluate online user behavior.
4. CO4: Design and implement interactive dashboards for visualizing analytics results.
5. CO5: Utilize data visualization best practices for communicating findings to stakeholders...
6. CO6: Integrate analytics with marketing strategies to enhance online presence and engagement.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1: Introduction to Web and Social Media Analytics Definition, scope, and significance of web analytics; Difference between web analytics and social media analytics; Key terminologies (hits, page views, unique visitors, sessions, bounce rate, CTR, etc.); Understanding digital user journeys; Overview of analytics tools (Google Analytics, Matomo, Social Blade, etc.).	06	CO1
2	Module2 Data Acquisition from Web and Social Media Introduction to web scraping; APIs for social media platforms (Twitter API, Facebook Graph API, YouTube API, Instagram API); Data formats (JSON, XML, CSV); Ethical and legal considerations in data collection; Automation with Python scripts; Self-learning topics: Basic HTML and DOM structure for scraping	07	CO2
3	Module3: Data Preprocessing and Cleaning Handling missing values, removing duplicates, dealing with noise; Text preprocessing (tokenization, stopword removal, stemming, lemmatization); Handling time-series social media data; Merging and joining datasets; Data transformation and normalization	06	CO2,CO3
4	Module4: Metrics, KPIs, and Social Media Engagement Analysis Defining and calculating key metrics (reach, impressions, engagement rate, sentiment score); Sentiment analysis techniques (lexicon-based, machine learning-based); Tools for sentiment analysis (VADER, TextBlob, spaCy); Hashtag and keyword trend analysis; Influencer impact analysis	08	CO3,CO6
5	Module 5: Data Visualization Techniques Principles of effective data visualization; Choosing the right chart type; Tools: Tableau, Power BI, Google Data Studio, Python libraries (Matplotlib, Seaborn, Plotly); Interactive dashboards; Case studies on marketing performance visualization	09	CO4,CO5



6	Module6: Integrating Analytics into Marketing Strategy Campaign tracking and analysis; A/B testing and conversion optimization; Linking analytics to ROI; Competitor benchmarking; Social listening and brand monitoring; Reporting best practices	06	CO5,CO6
7	Module 7 : Advanced Topics and Trends in Web & Social Media Analytics AI in analytics; Predictive modeling for social media trends; Real-time analytics pipelines; Privacy-preserving analytics; Cross-platform data integration	06	CO1,CO6

Text Books:

1. Kaushik, A. Web Analytics 2.0: The Art of Online Accountability & Science of Customer Centricity, Sybex, ISBN: 978-0470529393.
2. Fan, W., & Gordon, M.D. Social Media Analytics: Techniques and Insights for Extracting Business Value out of Social Media, Springer, ISBN: 978-3319173401.
3. Few, S. Show Me the Numbers: Designing Tables and Graphs to Enlighten, Analytics Press, ISBN: 978-0970601971.
4. Provost, F., & Fawcett, T. Data Science for Business, O'Reilly Media, ISBN: 978-1449361327.
5. Kotu, V., & Deshpande, B. Predictive Analytics and Data Mining: Concepts and Practice with RapidMiner, Morgan Kaufmann, ISBN: 978-0128014608.

Reference Books:

1. Sharda, R., Delen, D., & Turban, E. Business Intelligence, Analytics, and Data Science: A Managerial Perspective, Pearson, ISBN: 978-0135192016.
2. McKinney, W. Python for Data Analysis, O'Reilly Media, ISBN: 978-1491957660.
3. Yau, N. Data Points: Visualization That Means Something, Wiley, ISBN: 978-1118462195.
4. Zarrella, D. The Social Media Marketing Book, O'Reilly Media, ISBN: 978-0596806606.
5. Marr, B. Data Strategy: How to Profit from a World of Big Data, Analytics and the Internet of Things, Kogan Page, ISBN: 978-0749479855.



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Web References:

1. Google Analytics Help Center
2. Tableau Official Resources



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Elective: Artificial Intelligence and Machine Learning

Semester - IV Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-44	Big Data Processing with Hadoop Ecosystem	04	-	-	04	04

Prerequisites:

1. Basic understanding of database systems and SQL.
2. Knowledge of Java or Python programming.

Subject Objectives:

1. Understand the fundamental concepts and characteristics of Big Data and the Hadoop ecosystem.
2. Learn the architecture, components, and operation of Hadoop Distributed File System (HDFS).
3. Gain hands-on experience with MapReduce programming and optimization techniques.
4. Explore advanced Hadoop ecosystem tools such as Hive, Pig, HBase, and Spark.
5. Apply Hadoop-based solutions to real-world big data problems and case studies.

Subject Outcome: Learner will be able to

1. **CO1** Describe Big Data concepts, characteristics, and applications in industry.
2. **CO2:** Explain Hadoop architecture, HDFS structure, and configuration.
3. **CO3:** Develop MapReduce programs for large-scale data processing.
4. **CO4:** Use Hive and Pig for data analysis and querying on Hadoop.
5. **CO5:** Apply NoSQL data handling using HBase within the Hadoop ecosystem.
6. **CO6:** Implement and optimize Spark-based big data solutions.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1 Introduction to Big Data and Hadoop Big Data definition, characteristics (Volume, Velocity, Variety, Veracity, Value), Big Data applications and case studies. Hadoop ecosystem overview, history and evolution, core components. Limitations of traditional data processing systems. Self-learning topics: Emerging big data trends.	06	CO1
2	Module 2 HDFS Architecture and Operations Hadoop architecture, HDFS concepts (blocks, replication, Namenode, Datanode, Secondary Namenode), file read/write operations, data flow, fault tolerance. Hadoop configuration and setup. Self-learning topics: HDFS federation and high availability.	07	CO2
3	Module3: MapReduce Programming MapReduce paradigm, job execution flow, mapper and reducer implementation in Java/Python, combiners, partitioners, counters. Performance tuning and optimization techniques. Self-learning topics: YARN resource management.	07	CO3
4	Module4 : Hive for Data Warehousing Hive architecture, HiveQL, data types, tables, partitions, bucketing, managed and external tables, querying large datasets, integration with HDFS. Self-learning topics: User Defined Functions (UDFs) in Hive.	06	CO4
5	Module 5: Pig for Data Transformation Pig architecture, Pig Latin language, data loading, transformation, filtering, grouping, and joining. Performance considerations and integration with HDFS. Self-learning topics: Pig UDFs.	06	CO4
6	Module6: HBase for NoSQL Data Management HBase architecture, data model, tables, column families, CRUD operations, integration with MapReduce, HBase shell commands. Self-learning topics: HBase and Apache Phoenix.	06	CO5



7	Module 7 : Spark for Big Data Analytics Introduction to Apache Spark, RDDs, transformations and actions, Spark SQL, DataFrames, Spark Streaming basics. Comparison with MapReduce. Self-learning topics: MLlib basics in Spark.	08	CO6
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Text Books:

1. Tom White, Hadoop: The Definitive Guide, 4th Edition, O'Reilly Media, 2015. ISBN: 978-1491901632
2. Alex Holmes, Hadoop in Practice, 2nd Edition, Manning, 2015. ISBN: 978-1617292224
3. Garry Turkington, Hadoop Beginner's Guide, Packt Publishing, 2013. ISBN: 978-1782165042
4. Srinath Perera & Thilina Gunarathne, Hadoop MapReduce Cookbook, 2nd Edition, Packt, 2013. ISBN: 978-1782167060
5. Sam R. Alapati, Hadoop Administration, McGraw-Hill Education, 2016. ISBN: 978-0071846756

Reference Books:

1. Alan Gates, Programming Pig, O'Reilly Media, 2016. ISBN: 978-1491937099
2. Lars George, HBase: The Definitive Guide, O'Reilly Media, 2011. ISBN: 978-1449396107
3. Dean Wampler & Jason Rutherglen, Programming Hive, O'Reilly Media, 2012. ISBN: 978-1449319335
4. Bill Chambers & Matei Zaharia, Spark: The Definitive Guide, O'Reilly Media, 2018. ISBN: 978-1491912218
5. Vignesh Prajapati, Big Data Analytics with R and Hadoop, Packt Publishing, 2013. ISBN: 978-1782163284

Web References:

1. <https://hadoop.apache.org>
2. <https://spark.apache.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-45	IoT, Cloud Computing, and Watson Analytics	04	-	-	04	04

Prerequisites:

1. Basic knowledge of networking and databases.
2. Familiarity with programming concepts and basic Python or Java.

Subject Objectives:

1. To understand the fundamentals and architecture of Internet of Things (IoT).
2. To explore the design and development of IoT-based applications and devices.
3. To learn concepts of cloud computing, deployment models, and services.
4. To integrate IoT solutions with cloud platforms for data storage, processing, and analytics.
5. To apply Watson Analytics for predictive and cognitive insights from IoT-generated data.

Subject Outcome: Learner will be able to

1. CO1 Explain IoT concepts, architecture, protocols, and communication models.
2. CO2: Design IoT systems with appropriate sensors, actuators, and embedded devices.
3. CO3: Demonstrate the use of cloud computing concepts and deployment in IoT.
4. CO4: Integrate IoT systems with cloud services for real-time data management.
5. CO5: Apply Watson Analytics for advanced data analysis and visualization.
6. CO6: Develop an end-to-end IoT application using cloud integration and analytics.



Module No.	Detailed Content	Hours	CO Mapping
1	Module1 Introduction to IoT Overview of IoT, Characteristics of IoT, IoT Architecture (Perception, Network, Application layers), IoT Communication Models (Device-to-Device, Device-to-Cloud, Device-to-Gateway), IoT Protocols (MQTT, CoAP, HTTP, AMQP), IoT Enabling Technologies (Wireless Sensor Networks, RFID, 5G, LPWAN). Self-learning topics: IoT applications in Smart Cities, Healthcare, and Industry 4.0.	06	CO1
2	Module2 IoT Hardware and Software Components Sensors, Actuators, Embedded Systems, Microcontrollers (Arduino, ESP32, Raspberry Pi), Power Management, IoT Operating Systems (RIOT, Contiki), IoT Middleware Platforms. Self-learning topics: Comparative study of IoT hardware platforms.	07	CO2
3	Module3: Cloud Computing Fundamentals Overview and characteristics of Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Deployment Models (Public, Private, Hybrid, Community), Virtualization Concepts, Cloud Storage Systems. Self-learning topics: Leading cloud service providers and their offerings.	07	CO3
4	Module4 : IoT and Cloud Integration IoT Cloud Architecture, IoT Data Flow in Cloud, Data Ingestion, Data Processing, Real-Time Analytics in Cloud, Cloud APIs for IoT, Cloud-based IoT Platforms (AWS IoT Core, Azure IoT Hub, IBM Watson IoT). Self-learning topics: Case study on smart agriculture using IoT and cloud.	07	CO4
5	Module 5: Watson Analytics for IoT Overview of IBM Watson Analytics, Data Import and Preparation, Building Dashboards, Predictive Modeling, Cognitive Insights, Natural Language Processing in Watson Analytics. Self-learning topics: Industry use cases of Watson Analytics in IoT projects.	06	CO5



6	Module6: Security and Privacy in IoT and Cloud: IoT Security Challenges, Authentication and Authorization, Data Privacy, Cloud Security Standards (ISO 27017, CSA), Security Frameworks for IoT Systems. Self-learning topics: Blockchain in IoT security.	06	CO1, CO4
7	Module 7 : IoT Project Development Requirement Analysis, Device and Sensor Selection, Cloud Platform Setup, Data Processing Pipelines, Analytics Integration, Testing and Deployment. Self-learning topics: Creating a prototype IoT system using Watson IoT Platform.	07	CO2, CO6

Text Books:

1. Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Morgan Kaufmann, ISBN: 9780128053959
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, ISBN: 9780996025515
3. Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Springer, ISBN: 9783319546453
4. Milind Harakere, IBM Watson Analytics: The Ultimate Guide, IBM Press, ISBN: 9780134800704
5. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, ISBN: 9781466577008

Reference Books:

1. Dieter Uckelmann, Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Springer, ISBN: 9783642191564
2. Thomas Erl, Zaigham Mahmood, Cloud Computing Design Patterns, Prentice Hall, ISBN: 9780133387527
3. Sunil Cheruvu et al., Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, Springer, ISBN: 9783319448573
4. Pethuru Raj, Anupama Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, ISBN: 9781498761284
5. Srinivasa K. G., Internet of Things: Principles and Paradigms, Springer, ISBN: 9783030372211



Web References:

1. <https://internetofthingsagenda.techtarget.com>
2. <https://www.ibm.com/watson>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-20	Principles and Practices of Software Testing	04	-	-	04	04

Prerequisites:

1. Knowledge of programming languages and software development lifecycle
2. Understanding of basic logic and control structures
3. Familiarity with requirement analysis and design principles

Subject Objectives:

1. Understand fundamental concepts and methodologies of software testing
2. Learn various levels and types of testing
3. Apply test case design techniques and automation principles
4. Understand defect management and testing documentation
5. Gain hands-on skills in test planning, execution, and reporting

Subject Outcome: Learner will be able to

1. CO1: Explain testing objectives, strategies, and processes
2. CO2: Apply functional and structural test design techniques
3. CO3: Understand levels of testing and perform integration and system testing
4. CO4: Use tools for test automation and defect tracking
5. CO5: Design comprehensive test plans and maintain test documentation
6. CO6: Conduct effective reviews, audits, and quality assurance practices



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Software Testing Principles of testing, Software quality, SDLC vs. STLC, Role of testing in SDLC, Testing myths, Test process and policy Self learning topics: IEEE standards on testing	06	CO1
2	Test Design Techniques Black-box testing: Equivalence partitioning, Boundary value analysis, Decision table, State transition, Use case testing. White-box testing: Statement, branch, path coverage. Self learning topics: Use case testing for login modules	10	CO2
3	Levels and Types of Testing Unit testing, Integration testing (Top-down, Bottom-up), System testing, Acceptance testing. Regression, smoke, sanity, alpha-beta, and usability testing. Self learning topics: Preparing integration test cases	10	CO3
4	Automation Testing Tools Introduction to automation testing, Selenium basics, TestNG framework, Recording and running tests, Script maintenance, Assertions. Self learning topics: Writing Selenium scripts for form validation	10	CO4
5	Test Management and Defect Life Cycle Test planning, Test case documentation, Test data preparation, Defect lifecycle and classification, Bug reporting tools: JIRA, Bugzilla. Self learning topics: Using JIRA for defect logging and tracking	12	CO5
6	Quality Assurance and Reviews Software quality metrics, Quality audits, Review techniques (peer reviews, inspections), Risk-based testing, Code walkthroughs. Self learning topics: Performing checklist-based code review	12	CO6



Text Books:

1. Software Testing Principles and Practices – Srinivasan Desikan, Gopalaswamy Ramesh, Pearson, ISBN: 9788131708989
2. Foundations of Software Testing – Dorothy Graham, Erik van Veenendaal, Pearson, ISBN: 9788131724170

Reference Books:

1. Effective Software Testing – Elfriede Dustin, Addison-Wesley, ISBN: 9780321146533
2. Software Testing: A Craftsman's Approach – Paul C. Jorgensen, CRC Press, ISBN: 9780367332244
3. Selenium Testing Tools Cookbook – Unmesh Gundecha, Packt Publishing, ISBN: 9781784392514

Web References:

1. <https://www.istqb.org>
2. <https://junit.org>
3. <https://www.selenium.dev>
4. <https://www.softwaretestinghelp.com>
5. <https://www.atlassian.com/software/jira>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-21	Technical Writing and Communication for IT Professionals	02	-	-	02	02

Prerequisites:

1. Basic understanding of grammar and sentence construction
2. Familiarity with technical terms used in IT and software development
3. Interest in documentation, writing, and communication

Subject Objectives:

1. Develop technical writing skills specific to the IT domain
2. Learn effective document design and structuring for technical materials
3. Practice writing user manuals, reports, and software documentation
4. Enhance oral and written communication for professional settings
5. Understand the role of documentation in project and product development

Subject Outcome: Learner will be able to

1. CO1: Understand the principles and practices of effective technical writing
2. CO2: Apply techniques to write and organize technical documents for varied audiences
3. CO3: Create documentation such as user guides, technical reports, and white papers
4. CO4: Use documentation tools and templates used in industry
5. CO5: Communicate effectively in workplace scenarios (emails, reports, meetings)
6. CO6: Analyze and improve clarity, coherence, and usability in technical content



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Technical Writing Definition, Importance, Objectives, Characteristics of technical communication, Technical vs. Non-technical writing, Role of technical writers in IT. Self learning topics: Examples of poor vs. effective documentation	06	CO1
2	Writing Process and Document Design Planning, Drafting, Revising, Editing, Proofreading. Document formats, layout, font and style guidelines, content organization, visuals and infographics .Self learning topics: Using document style guides	10	CO2
3	Types of Technical Documents User manuals, installation guides, system documentation, release notes, white papers, case studies, API documentation, functional specs. Self learning topics: Mapping document type to user needs	10	CO3
4	Tools and Technologies for Documentation MS Word, Google Docs, Markdown, LaTeX, Snagit, Version control, Wikis, Online Help systems. Basics of content management systems .Self learning topics: Using Markdown and Git for documentation	10	CO4
5	Communication in the IT Workplace Email etiquette, Meeting notes and MoMs, Status reporting, Proposal writing, Communication in project teams, Conflict resolution techniques. Self learning topics: Common communication pitfalls in tech teams	12	CO5
6	Improving Clarity, Usability, and Accessibility Clarity and simplicity, Readability indexes, User-centered design in documentation, Language sensitivity, Accessibility standards (WCAG), Inclusive language. Self learning topics: Revising unclear technical text	12	CO6



Text Books:

1. Technical Communication – Meenakshi Raman & Sangeeta Sharma, Oxford University Press, ISBN: 9780195695747
2. A Guide to Writing as an Engineer – David Beer & David McMurrey, Wiley, ISBN: 9781118300271

Reference Books:

1. Handbook of Technical Writing – Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, Bedford/St. Martin's, ISBN: 9781457675522
2. Developing Quality Technical Information – Gretchen Hargis et al., IBM Press, ISBN: 9780131477490
3. Read Me First! A Style Guide for the Computer Industry – Sun Technical Publications, Prentice Hall, ISBN: 9780131428997

Web References:

1. <https://developers.google.com/style>
2. <https://techwhirl.com>
3. <https://www.w3.org/WAI/standards-guidelines>
4. <https://opensource.com>
5. <https://www.plainlanguage.gov>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-22	Capstone Project	08	-	-	08	08

Prerequisites:

1. Successful completion of core programming, design, and database subjects
2. Basic understanding of software project development lifecycle
3. Familiarity with at least one cloud platform or web development framework

Subject Objectives:

1. Provide hands-on experience in designing and developing a complete project
2. Integrate knowledge from multiple subjects to solve real-world problems
3. Apply SDLC principles in a practical environment
4. Foster teamwork, problem-solving, and project management skills
5. Demonstrate outcomes through presentation, report, and deployment

Subject Outcome: Learner will be able to

1. CO1: Define, design, and scope a real-time software/cloud-based project
2. CO2: Apply SDLC practices in planning, development, and testing
3. CO3: Develop and integrate functional components into a full application
4. CO4: Work effectively in teams and maintain project documentation
5. CO5: Demonstrate and deploy a working prototype or final product
6. CO6: Evaluate the effectiveness of solutions through testing and feedback



Module No.	Detailed Content	Hours	CO Mapping
1	Capstone Project Development Project identification and problem definition, requirement analysis, design and technology selection, database and API integration, implementation, testing, deployment. Includes project proposal, planning documents, mid-term demo, final report, and presentation. Self learning topics: Exploring open-source project ideas, identifying community challenges, reading GitHub repositories for inspiration	60	CO1, CO2, CO3, CO4, CO5, CO6

Text Books:

1. Software Engineering – Ian Sommerville, Pearson, ISBN: 9789332582705
2. Agile Project Management with Scrum – Ken Schwaber, Microsoft Press, ISBN: 9780735619933

Reference Books:

1. The Lean Startup – Eric Ries, ISBN: 9780307887894
2. Project Management for the Unofficial Project Manager – Kory Kogon, FranklinCovey, ISBN: 9781941631102
3. Software Project Survival Guide – Steve McConnell, Microsoft Press, ISBN: 9780735605356

Web References:

1. <https://github.com>
2. <https://www.scrum.org>
3. <https://www.atlassian.com/agile>
4. <https://opensource.guide>
5. <https://devpost.com>



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Elective: Cyber Security

Semester – III

Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-15	Foundation of Cybersecurity	04	-	-	04	04

Prerequisites:

1. Basic knowledge of computer networks and operating systems
2. Familiarity with fundamental programming concepts

Subject Objectives:

1. Understand the fundamental principles and concepts of cybersecurity.
2. Identify different types of cyber threats, vulnerabilities, and attacks.
3. Learn security mechanisms, cryptographic techniques, and authentication methods.
4. Develop knowledge of security policies, standards, and best practices.
5. Apply cybersecurity concepts in real-world scenarios to secure systems and networks.

Subject Outcome: Learner will be able to

1. CO 1: Explain the foundational concepts of cybersecurity and its importance in modern computing.
2. CO 2: Identify and classify various cyber threats, vulnerabilities, and attack methods.
3. CO 3: Apply cryptographic methods and authentication techniques to protect information.
4. CO 4: Evaluate and implement network and system security controls.
5. CO 5: Interpret cybersecurity policies, standards, and legal considerations.
6. CO 6: Apply risk management and incident response techniques in practical scenarios.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Cybersecurity: Definition, Scope, and Importance; Security Goals – Confidentiality, Integrity, Availability (CIA triad); Cybersecurity Architecture; Cybersecurity Domains; Security Challenges in Cloud, Mobile, and IoT; Role of Cybersecurity in Business Continuity; Ethical and Legal Aspects in Security. Self-learning topics: Historical case studies of major cyber incidents.	06	CO1
2	Cyber Threats and Vulnerabilities: Types of threats – Malware, Phishing, Ransomware, DoS/DDoS, Advanced Persistent Threats (APTs), Insider Threats, Social Engineering; Vulnerabilities – Software flaws, Hardware weaknesses, Configuration errors, Human Factors; Threat Modeling and Attack Surface Analysis; Common Exploits and Attack Vectors. Self-learning topics: OWASP Top 10 vulnerabilities.	07	CO2
3	Cryptography and Authentication: Symmetric and Asymmetric Encryption (DES, AES, RSA, ECC), Public Key Infrastructure (PKI) and Digital Certificates, Hashing (SHA, MD5) and Message Authentication Codes, Digital Signatures, Authentication Factors – Passwords, Biometrics, Tokens, Multi-factor Authentication; Key Management Practices; Cryptographic Protocols – SSL/TLS, IPsec. Self-learning topics: Blockchain-based authentication methods.	09	CO3
4	Network and System Security: Network Segmentation, Firewalls (Packet filtering, Stateful inspection, Application-level gateways), Intrusion Detection/Prevention Systems (IDS/IPS), Virtual Private Networks (VPNs), Wireless Security (WPA3), Endpoint Security, Patch and Vulnerability Management, Host Hardening, Secure Boot, Secure Configuration Baselines. Self-learning topics: Security configurations in Linux/Windows.	07	CO4
5	Security Policies, Standards, and Compliance: Overview of Cybersecurity Governance; International Standards – ISO/IEC 27001, NIST Cybersecurity Framework; Compliance Laws – GDPR, HIPAA, PCI-DSS; Organizational Security Policies – Access Control, Acceptable Use, Data Classification; Policy Development Life Cycle; Security Awareness and Training Programs. Self-learning topics: Security audits and certifications.	06	CO5



6	Risk Management and Incident Response: Risk Assessment Methodologies (Qualitative and Quantitative), Threat Intelligence Sources, Vulnerability Scanning and Penetration Testing, Incident Response Phases (Preparation, Detection, Containment, Eradication, Recovery), Digital Forensics Basics, Evidence Handling, Disaster Recovery and Business Continuity Planning. Self-learning topics: Case study of a recent cyber breach.	06	CO6
7	Emerging Trends in Cybersecurity: Cloud Security (Shared Responsibility Model, CASB tools), IoT Security Challenges and Solutions, AI and Machine Learning for Threat Detection, Zero Trust Architecture, Blockchain Applications in Security, Quantum Computing Impact on Cryptography. Self-learning topics: Predicting future threat landscapes.	08	CO1

Text Books:

1. Stallings, W., Cryptography and Network Security: Principles and Practice, Pearson.
2. Pfleeger, C. P., & Pfleeger, S. L., Security in Computing, Pearson.
3. Bishop, M., Computer Security: Art and Science, Addison-Wesley.
4. Schneier, B., Applied Cryptography, Wiley.
5. Anderson, R., Security Engineering: A Guide to Building Dependable Distributed Systems, Wiley.

Reference Books:

1. Shon Harris, CISSP All-in-One Exam Guide, McGraw-Hill.
2. Ross, J., Cybersecurity: The Essential Body of Knowledge, Cengage Learning.
3. Whitman, M. E., & Mattord, H. J., Principles of Information Security, Cengage Learning.
4. Cole, E., Network Security Bible, Wiley.
5. Kizza, J. M., Computer Network Security, Springer.

Web References:

1. <https://www.nist.gov/cyberframework>
2. <https://owasp.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-46	Network Security and Protocols	04	-	-	04	04

Prerequisites:

1. Basic knowledge of computer networks and TCP/IP model.
2. Familiarity with operating systems and basic programming concepts.

Subject Objectives:

1. Understand the principles, architecture, and protocols of secure networks.
2. Analyze common security threats and their mitigation techniques in network environments.
3. Learn cryptographic algorithms and secure communication protocols.
4. Apply network monitoring, intrusion detection, and firewall configurations.
5. Evaluate security policies, standards, and best practices for secure network design.

Subject Outcome: Learner will be able to

1. CO 1: Explain the fundamental concepts and architecture of network security.
2. CO 2: Identify and analyze network threats, vulnerabilities, and associated risks.
3. CO 3: Apply cryptographic methods and secure protocols for data protection.
4. CO 4: Configure and evaluate network security devices and mechanisms.
5. CO 5: Interpret and implement network security standards and policies.
6. CO 6: Design secure network architectures considering emerging security technologies.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Network Security: Definition, objectives, and importance of network security; Security services and mechanisms; Security attacks – Passive and Active; Overview of OSI and TCP/IP security issues; Security challenges in wired, wireless, and mobile networks. Self-learning topics: Historical evolution of network security.	06	CO1
2	Network Threats, Vulnerabilities, and Attacks: Malware, DoS/DDoS, Man-in-the-Middle, Session Hijacking, DNS Spoofing, ARP Poisoning, Port Scanning, Advanced Persistent Threats (APTs), Insider threats; Vulnerability assessment tools. Self-learning topics: OWASP Top 10 for network-based vulnerabilities.	07	CO2
3	Cryptography for Network Security: Symmetric key algorithms (DES, AES, ChaCha20), Asymmetric key algorithms (RSA, ECC), Hashing (SHA family, MD5), Digital signatures, Key exchange (Diffie-Hellman), Message authentication codes. Self-learning topics: Post-quantum cryptography basics.	08	CO3
4	Secure Communication Protocols: SSL/TLS, HTTPS, SSH, IPsec (AH and ESP modes), VPNs, Wireless security protocols (WPA3, 802.1X), Secure Email protocols (S/MIME, PGP). Self-learning topics: QUIC protocol and its security features.	08	CO3, CO4
5	Network Security Devices and Architectures: Firewalls (Packet filtering, Stateful, Application), IDS/IPS, Network segmentation, DMZ, Bastion hosts, Proxy servers, Secure router configuration, Network Access Control (NAC). Self-learning topics: Security in SDN (Software Defined Networks).	07	CO4
6	Security Policies, Standards, and Compliance in Networking: ISO/IEC 27033, NIST SP 800-53 for networks, GDPR and data protection in transit, Policy frameworks for access control, Encryption standards for data-in-transit. Self-learning topics: Case study on policy violations and consequences.	06	CO5
7	Emerging Trends in Network Security: Zero Trust Networking, AI and ML in threat detection, Blockchain for secure communications, Cloud network security models, Quantum computing implications on network protocols. Self-learning topics: Predictive network threat analysis.	08	CO6



Text Books:

1. Stallings, W., Cryptography and Network Security: Principles and Practice, Pearson.
2. Kaufman, C., Perlman, R., & Speciner, M., Network Security: Private Communication in a Public World, Pearson.
3. Forouzan, B. A., Cryptography and Network Security, McGraw-Hill.
4. Kurose, J. F., & Ross, K. W., Computer Networking: A Top-Down Approach, Pearson.
5. Schneier, B., Applied Cryptography, Wiley.

Reference Books:

1. Cole, E., Network Security Bible, Wiley.
2. Pfleeger, C. P., & Pfleeger, S. L., Security in Computing, Pearson.
3. Anderson, R., Security Engineering: A Guide to Building Dependable Distributed Systems, Wiley.
4. Conklin, W. A., et al., Principles of Computer Security, McGraw-Hill.
5. Kizza, J. M., Computer Network Security, Springer.

Web References:

1. <https://www.nist.gov/cyberframework>
2. <https://owasp.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-47	Cryptography and Secure Communication	04	-	-	04	04

Prerequisites:

1. Basic knowledge of computer networks and operating systems.
2. Familiarity with fundamental programming and data structures.

Subject Objectives:

1. Understand the fundamental concepts, goals, and models of cryptography.
2. Learn various encryption, decryption, and key management techniques.
3. Explore authentication protocols, digital signatures, and integrity mechanisms.
4. Analyze secure communication protocols and evaluate their strengths and vulnerabilities.
5. Investigate modern trends and challenges in secure communication systems.

Subject Outcome: Learner will be able to

1. CO1: Explain the basic concepts, principles, and objectives of cryptography and secure communication.
2. CO 2: Apply classical and modern encryption techniques for data protection.
3. CO 3: Design and analyze key management and authentication mechanisms.
4. CO 4: Implement and evaluate secure communication protocols.
5. CO 5: Identify and mitigate potential vulnerabilities in cryptographic systems.
6. CO 6: Examine emerging cryptographic technologies and their implications on future communication security.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Cryptography and Security Goals: Definitions, History of Cryptography, Security Goals (Confidentiality, Integrity, Availability, Non-repudiation); Cryptographic Models – Symmetric, Asymmetric, Hybrid; Cryptanalysis Basics; Applications of Cryptography in Secure Communication; Ethical, Legal, and Regulatory Aspects. <i>Self-learning:</i> Famous cryptographic failures and their lessons.	06	CO1
2	Classical Encryption Techniques: Substitution Ciphers (Caesar, Monoalphabetic, Playfair, Vigenère), Transposition Ciphers, Rotor Machines; Steganography; Cryptanalysis of Classical Ciphers. <i>Self-learning:</i> Use of classical ciphers in historical communication.	07	CO2
3	Modern Symmetric Cryptography: Block Ciphers (DES, 3DES, AES, Blowfish, Twofish), Stream Ciphers (RC4, Salsa20), Modes of Operation (ECB, CBC, CFB, OFB, CTR); Random Number Generation and Cryptographic Security; Key Distribution Methods. <i>Self-learning:</i> Implementation of AES in a programming language.	09	CO2, CO4
4	Public-Key Cryptography and Key Management: RSA, ElGamal, ECC; Diffie–Hellman Key Exchange; Digital Signatures (RSA, DSA, ECDSA); Public Key Infrastructure (PKI), Certificates, Certificate Authorities; Key Lifecycle Management; Trust Models. <i>Self-learning:</i> Blockchain-based PKI systems.	08	CO3, CO4
5	Authentication and Integrity Mechanisms: Message Authentication Codes (MAC), Hash Functions (MD5, SHA family, Keccak/SHA-3), HMAC; Authentication Protocols – Challenge-Response, Zero-Knowledge Proofs; Multifactor Authentication; Biometric Authentication. <i>Self-learning:</i> Password hashing best practices.	07	CO3
6	Secure Communication Protocols: SSL/TLS, HTTPS, IPsec, Secure Shell (SSH), Pretty Good Privacy (PGP), Secure/Multipurpose Internet Mail Extensions (S/MIME); Wireless Security Protocols (WPA3, EAP); End-to-End Encryption in Messaging. <i>Self-learning:</i> Analysis of TLS handshake process.	08	CO4, CO5
7	Advanced and Emerging Cryptographic Techniques: Quantum Cryptography and Post-Quantum Algorithms; Homomorphic Encryption; Lattice-based Cryptography; Blockchain and Distributed Ledger	09	CO6



	Security; Privacy-preserving Technologies; Current Research Trends in Cryptography. Self-learning: Case study on quantum-safe cryptographic standards.		
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Text Books:

1. Stallings, W., Cryptography and Network Security: Principles and Practice, Pearson.
2. Schneier, B., Applied Cryptography, Wiley.
3. Menezes, A. J., van Oorschot, P. C., & Vanstone, S. A., Handbook of Applied Cryptography, CRC Press.
4. Katz, J., & Lindell, Y., Introduction to Modern Cryptography, CRC Press.
5. Paar, C., & Pelzl, J., Understanding Cryptography: A Textbook for Students and Practitioners, Springer.

Reference Books:

1. Anderson, R., Security Engineering: A Guide to Building Dependable Distributed Systems, Wiley.
2. Singh, S., The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography, Anchor.
3. Koblitz, N., A Subject in Number Theory and Cryptography, Springer.
4. Ferguson, N., Schneier, B., & Kohno, T., Cryptography Engineering, Wiley.
5. Smart, N. P., Cryptography: An Introduction, McGraw-Hill.

Web References:

1. <https://www.nist.gov/itl/applied-cybersecurity>
2. <https://owasp.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-48	Ethical Hacking and Penetration Testing	04	-	-	04	04

Prerequisites:

1. Basic knowledge of computer networks, operating systems, and internet protocols.
2. Familiarity with fundamental programming concepts and Linux command-line usage.

Subject Objectives:

1. Understand the fundamentals, scope, and ethics of ethical hacking and penetration testing.
2. Learn various reconnaissance and footprinting techniques to gather information about targets.
3. Explore vulnerability assessment, exploitation, and privilege escalation methods.
4. Apply penetration testing methodologies for different platforms and environments.
5. Develop the ability to recommend security measures and prepare comprehensive penetration testing reports.

Subject Outcome: Learner will be able to

1. CO 1: Explain the ethical, legal, and technical aspects of ethical hacking and penetration testing.
2. CO 2: Perform reconnaissance, scanning, and enumeration to identify potential vulnerabilities.
3. CO 3: Conduct vulnerability assessments and exploit known weaknesses in systems.
4. CO 4: Apply exploitation and post-exploitation techniques for various operating systems and applications.
5. CO 5: Design and execute penetration testing strategies for networks, web applications, and wireless systems.
6. CO 6: Recommend mitigation strategies, prepare penetration testing reports, and comply with industry standards.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Ethical Hacking: Definitions, History of Hacking, Categories of Hackers (Black Hat, White Hat, Grey Hat), Phases of Ethical Hacking, Penetration Testing vs. Vulnerability Assessment, Legal and Ethical Considerations, Cybercrime Laws, Responsible Disclosure. <i>Self-learning:</i> Famous hacking incidents and their lessons.	06	CO1
2	Reconnaissance and Footprinting: Active and Passive Reconnaissance; WHOIS, DNS Interrogation, Network Mapping, Google Dorking; Social Engineering Basics; Email Footprinting; OSINT Tools and Frameworks (Maltego, Recon-ng). <i>Self-learning:</i> Advanced search engine hacking.	07	CO2
3	Scanning and Enumeration: Network Scanning Techniques (Ping Sweep, Port Scanning, Service Version Detection); Vulnerability Scanners (Nessus, OpenVAS); Enumeration of Network Services (FTP, SMB, SNMP, LDAP); Banner Grabbing; Nmap Scripting Engine. <i>Self-learning:</i> Automating scans with scripts.	08	CO2, CO3
4	System Hacking and Exploitation: Password Cracking (Dictionary, Brute Force, Rainbow Tables), Exploiting Vulnerabilities with Metasploit Framework, Buffer Overflow Basics, Privilege Escalation in Windows and Linux, Maintaining Access (Backdoors, Trojans). <i>Self-learning:</i> Exploiting a vulnerable virtual machine.	08	CO3, CO4
5	Web Application Penetration Testing: OWASP Top 10; SQL Injection, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF); File Inclusion Attacks; Command Injection; Web Shells; Burp Suite Usage. <i>Self-learning:</i> Setting up DVWA (Damn Vulnerable Web Application) for practice.	09	CO4, CO5
6	Wireless and Network Penetration Testing: Wireless Security Standards (WEP, WPA, WPA2, WPA3), Wireless Attacks (Evil Twin, Deauthentication, Packet Sniffing), Network Sniffing with Wireshark, MITM Attacks, ARP Spoofing. <i>Self-learning:</i> Conducting a packet capture and analysis.	07	CO5
7	Reporting, Mitigation, and Emerging Trends: Penetration Testing Report Writing, Risk Assessment, Security Recommendations, Incident Response Basics; Trends in Ethical Hacking – IoT Security, Cloud Penetration Testing, AI in Cybersecurity, Red Team vs. Blue Team Exercises.	09	CO6



	<i>Self-learning:</i> Preparing a sample PT report based on a simulated test.		
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Text Books:

1. EC-Council, Ethical Hacking and Countermeasures, Cengage Learning.
2. Kevin Beaver, Hacking For Dummies, Wiley.
3. Patrick Engebretson, The Basics of Hacking and Penetration Testing, Syngress.
4. Dafydd Stuttard & Marcus Pinto, The Web Application Hacker's Handbook, Wiley.
5. Georgia Weidman, Penetration Testing: A Hands-On Introduction to Hacking, No Starch Press.

Reference Books:

1. Jon Erickson, Hacking: The Art of Exploitation, No Starch Press.
2. Chris McNab, Network Security Assessment, O'Reilly Media.
3. Shon Harris, Gray Hat Hacking: The Ethical Hacker's Handbook, McGraw-Hill.
4. Peter Kim, The Hacker Playbook series, Secure Planet.
5. Thomas Wilhelm, Professional Penetration Testing, Syngress.

Web References:

1. <https://owasp.org>
2. <https://www.exploit-db.com>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S3-49	Cyber Laws and Digital Forensics	04	-	-	04	04

Prerequisites:

1. Basic understanding of computer networks, operating systems, and databases.
2. Familiarity with concepts of information security and file systems.

Subject Objectives:

1. Understand the national and international legal frameworks applicable to cyberspace.
2. Learn about various types of cybercrimes and corresponding legal remedies.
3. Gain knowledge of digital forensics principles, tools, and methodologies.
4. Develop skills for evidence acquisition, preservation, and analysis in compliance with legal standards.
5. Examine ethical considerations and emerging challenges in cyber law enforcement and digital investigations.

Subject Outcome: Learner will be able to

1. CO 1: Explain the fundamental concepts of cyber laws, cybercrimes, and relevant legislation.
2. CO 2: Identify and analyze various types of cyber offences and applicable legal provisions.
3. CO 3: Apply digital forensics methodologies for evidence acquisition and preservation.
4. CO 4: Use forensic tools to analyze digital evidence and prepare investigation reports.
5. CO 5: Interpret and present forensic findings in compliance with legal and ethical requirements.
6. CO 6: Evaluate emerging trends and challenges in cyber law and digital forensic practices.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Cyber Laws: Evolution of cyberspace and need for regulation; Information Technology Act, 2000 and amendments; International cyber law frameworks (Budapest Convention, GDPR, etc.); Jurisdiction in cyberspace; Role of CERT-In; Self-learning: Landmark cyber law cases.	06	CO1
2	Types of Cybercrimes and Legal Provisions: Hacking, phishing, identity theft, cyber terrorism, cyber stalking, cyberbullying, child exploitation, intellectual property violations, online frauds; Applicable sections under IT Act, IPC, and other relevant laws; Case studies. Self-learning: Analysis of famous cybercrime incidents.	07	CO1, CO2
3	Fundamentals of Digital Forensics: Principles of digital forensics; Types of digital evidence; Chain of custody; Digital evidence admissibility in court; Forensic readiness planning. Self-learning: Role of forensics in incident response.	06	CO3
4	Evidence Acquisition and Preservation: Imaging techniques (bit-stream, logical, live acquisition); Hashing and verification; Handling volatile and non-volatile data; Forensic duplication tools (FTK Imager, EnCase, dd, etc.); Documentation and reporting. Self-learning: Hands-on hashing exercise.	08	CO3, CO4
5	Analysis of Digital Evidence: File system forensics (FAT, NTFS, ext); Email forensics; Mobile device forensics; Network forensics; Malware analysis basics; Keyword search, timeline analysis; Tool demonstration (Autopsy, X-Ways, Wireshark). Self-learning: Recovering deleted files.	09	CO4
6	Presentation of Evidence in Legal Proceedings: Report writing, expert witness role, courtroom testimony, cross-examination techniques; Compliance with laws and ethical codes; Privacy considerations in forensic analysis. Self-learning: Mock courtroom testimony exercise.	07	CO5
7	Emerging Trends and Challenges: Cloud forensics; IoT forensics; Cryptocurrency and blockchain investigations; AI in digital forensics; Privacy-enhancing technologies; Legal gaps and policy recommendations. Self-learning: Research on future challenges in cyber law.	08	CO6



Text Books:

1. Nelson, B., Phillips, A., & Steuart, C., Guide to Computer Forensics and Investigations, Cengage.
2. Casey, E., Digital Evidence and Computer Crime, Academic Press.
3. Kizza, J. M., Guide to Computer Network Security, Springer.
4. Sharma, V., Cyber Laws and Information Technology, Wiley India.
5. Eoghan, C., Handbook of Digital Forensics and Investigation, Academic Press.

Reference Books:

1. Easttom, C., System Forensics, Investigation, and Response, Jones & Bartlett Learning.
2. Parker, D. B., Fighting Computer Crime, Wiley.
3. Maras, M.-H., Cybercriminology, Oxford University Press.
4. Singh, P., Cyber Law: Simplified, PHI Learning.
5. Altheide, C., & Carvey, H., Digital Forensics with Open Source Tools, Syngress.

Web References:

1. <https://www.interpol.int/en/Crimes/Cybercrime>
2. <https://nciipc.gov.in>



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Elective: Cyber Security

Semester – IV

Syllabus



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-19	Cloud Security and Risk Management	04	-	-	04	04

Prerequisites:

1. Basic knowledge of computer networks and operating systems.
2. Familiarity with cloud computing fundamentals and virtualization concepts.

Subject Objectives:

1. Introduce the concepts and principles of cloud security and its necessity in modern computing.
2. Examine cloud security architectures, models, and frameworks in various deployment scenarios.
3. Discuss identity and access management techniques in cloud environments.
4. Equip learners with skills to perform cloud-specific risk assessments and mitigation planning.
5. Analyze and apply incident response and business continuity strategies in the cloud context.

Subject Outcome: Learner will be able to

1. CO1: Explain fundamental cloud security principles, challenges, and service models.
2. CO 2: Identify and evaluate risks and vulnerabilities in cloud environments.
3. CO 3: Apply security controls, encryption methods, and compliance requirements to cloud deployments.
4. CO 4: Design identity and access management solutions for secure cloud operations.
5. CO 5: Develop incident response and disaster recovery plans for cloud-based systems.
6. CO 6: Assess emerging trends, technologies, and research in cloud security and risk management.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Cloud Security: Definitions and evolution of cloud computing; Cloud service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid, community); Shared responsibility model; Key security challenges and threat landscape; Cloud security governance. Self-learning: Case study on major cloud security breaches.	06	CO1
2	Cloud Security Architecture and Frameworks: CSA Cloud Controls Matrix (CCM); NIST Cloud Security Reference Architecture; ISO/IEC 27017 and 27018 standards; Security considerations for multi-cloud and hybrid environments; Secure cloud design principles. Self-learning: Compare NIST and CSA cloud security frameworks.	07	CO1, CO3
3	Risk Assessment in Cloud Environments: Cloud-specific risk identification; Threat modeling for cloud applications; Risk management lifecycle; Risk assessment tools and methodologies (OCTAVE, FAIR, ISO 31000); Third-party vendor risk management. Self-learning: Conduct a sample risk assessment using OCTAVE.	09	CO2
4	Identity and Access Management (IAM) in the Cloud: Authentication, authorization, and accounting (AAA); Single Sign-On (SSO); Multi-factor authentication (MFA); Role-Based Access Control (RBAC) and Attribute-Based Access Control (ABAC); Federated identity management (SAML, OAuth, OpenID Connect); Privileged Access Management (PAM). Self-learning: Implementing SSO in AWS.	08	CO4
5	Cloud Data Security and Compliance: Data classification, encryption (at rest, in transit, in use), key management, tokenization, data masking; Compliance regulations (GDPR, HIPAA, PCI-DSS, FedRAMP) and their implications for cloud systems; Cloud audit mechanisms. Self-learning: Explore AWS KMS or Azure Key Vault.	07	CO3
6	Incident Response and Business Continuity in the Cloud: Cloud-specific incident detection and response; Forensic readiness in cloud systems; Disaster recovery strategies (RPO, RTO); Backup and replication approaches; Business continuity planning for cloud workloads.	08	CO5



	Self-learning: Create a disaster recovery plan for a cloud-based web application.		
7	Emerging Trends and Advanced Topics in Cloud Security: Zero Trust Architecture in the cloud; Confidential computing; AI/ML for threat detection; Serverless security challenges; Quantum-safe encryption for cloud; Cloud-native security tools; Current research trends and case studies. Self-learning: Research on quantum-safe cloud cryptography.	09	CO6

Text Books:

1. Krutz, R. L., & Vines, R. D., Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley.
2. Mather, T., Kumaraswamy, S., & Latif, S., Cloud Security and Privacy, O'Reilly Media.
3. Winkler, V., Securing the Cloud: Cloud Computer Security Techniques and Tactics, Syngress.
4. Rittinghouse, J. W., & Ransome, J. F., Cloud Computing: Implementation, Management, and Security, CRC Press.
5. Chou, T. S., Security Threats in Cloud Computing, CreateSpace Independent Publishing.

Reference Books:

1. Shroff, G., Enterprise Cloud Computing: Technology, Architecture, Applications, Cambridge University Press.
2. Kaufman, L. M., Data Security in the Cloud, CRC Press.
3. Jansen, W., & Grance, T., Guidelines on Security and Privacy in Public Cloud Computing, NIST Special Publication.
4. Rezaei, R., Cloud Computing: Principles and Paradigms, Wiley.
5. Erl, T., Mahmood, Z., & Puttini, R., Cloud Computing: Concepts, Technology & Architecture, Prentice Hall.

Web References:

1. <https://cloudsecurityalliance.org>
2. <https://www.nist.gov/programs-projects/nist-cloud-computing-program>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-50	Security Operations and Incident Response	04	-	-	04	04

Prerequisites:

1. Basic knowledge of computer networks, operating systems, and cybersecurity concepts.
2. Familiarity with incident detection tools and log analysis basics.

Subject Objectives:

1. Understand the principles, processes, and frameworks of security operations and incident response.
2. Learn how to detect, analyze, contain, and eradicate security incidents effectively.
3. Explore Security Operations Center (SOC) architecture, tools, and workflows.
4. Study best practices for threat intelligence, log management, and forensic analysis.
5. Develop skills to prepare, implement, and evaluate incident response plans in real-world scenarios.

Subject Outcome: Learner will be able to

1. CO 1: Explain the fundamental concepts and frameworks of security operations and incident response.
2. CO 2: Identify and analyze various types of security incidents and threats.
3. CO 3: Apply security monitoring, log analysis, and threat detection techniques.
4. CO 4: Design and implement effective incident containment and eradication strategies.
5. CO 5: Conduct post-incident forensic analysis and prepare detailed reports.
6. CO 6: Integrate SOC operations with proactive security measures and continuous improvement processes.



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Security Operations and Incident Response: Concepts, importance, and objectives; Incident response lifecycle (NIST, SANS models); SOC overview – roles, responsibilities, and structure; Key challenges in modern incident handling; Regulatory and compliance requirements (GDPR, HIPAA, ISO 27035). Self-learning: Study of major historical cybersecurity incidents.	06	CO1
2	Threat Landscape and Attack Vectors: Types of cyber threats (malware, phishing, insider threats, APTs, ransomware); Attack surfaces; Cyber kill chain model; Common vulnerability types (CVEs, CWE); Threat actor profiling and motivations. Self-learning: Recent case studies on ransomware incidents.	07	CO2
3	Security Monitoring and Detection Techniques: Log sources (firewalls, IDS/IPS, SIEM, EDR); Correlation rules and alert triaging; Network traffic analysis; Anomaly vs. signature-based detection; Use of threat intelligence feeds and IOC indicators. Self-learning: Practical exercise on SIEM query writing.	09	CO3
4	Incident Analysis and Classification: Incident severity levels; Root cause analysis; Evidence collection procedures; Memory and disk acquisition; Timeline reconstruction; Chain of custody in digital forensics. Self-learning: Analysis of a real-world breach investigation report.	08	CO3, CO5
5	Containment, Eradication, and Recovery: Short-term and long-term containment strategies; Eradication techniques; System restoration; Patch management; Validation and testing post-incident; Communication during incident handling. Self-learning: Recovery checklist preparation.	07	CO4
6	Post-Incident Activities and Reporting: Lessons learned; Report writing for technical and non-technical audiences; Root cause mitigation; Updating security policies and controls; Continuous monitoring improvements. Self-learning: Create a sample incident report.	08	CO5, CO6
7	Advanced and Emerging Trends in Incident Response: Cloud incident response; Incident handling in IoT and OT environments; AI/ML in threat detection; Zero Trust architecture implications; Automation and orchestration (SOAR platforms); Red team vs. blue team exercises. Self-learning: Case study on AI-assisted SOC operations.	09	CO6



Text Books:

1. Mandia, K., Prorise, C., & Pepe, M., Incident Response & Computer Forensics, McGraw-Hill.
2. West, J., & Cunningham, K., Cybersecurity Incident Response: How to Contain, Eradicate, and Recover from Incidents, Apress.
3. Prorise, C., & Mandia, K., Incident Response: Investigating Computer Crime, McGraw-Hill.
4. Casey, E., Digital Evidence and Computer Crime, Academic Press.
5. Bejtlich, R., The Practice of Network Security Monitoring, No Starch Press.

Reference Books:

1. Killcrece, G., et al., Handbook for CSIRTs, Carnegie Mellon University/SEI.
2. Phillips, A., & Simon, K., Security Operations Center: Building, Operating, and Maintaining your SOC, Syngress.
3. Allen, J. H., et al., CERT Guide to Coordinated Vulnerability Disclosure, Addison-Wesley.
4. Grimes, R., Malware Analyst's Cookbook and DVD, Wiley.
5. Bayuk, J., Cyber Security Policy Guidebook, Wiley.

Web References:

1. <https://www.first.org>
2. <https://attack.mitre.org>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-20	Principles and Practices of Software Testing	04	-	-	04	04

Prerequisites:

1. Knowledge of programming languages and software development lifecycle
2. Understanding of basic logic and control structures
3. Familiarity with requirement analysis and design principles

Subject Objectives:

1. Understand fundamental concepts and methodologies of software testing
2. Learn various levels and types of testing
3. Apply test case design techniques and automation principles
4. Understand defect management and testing documentation
5. Gain hands-on skills in test planning, execution, and reporting

Subject Outcome: Learner will be able to

1. CO1: Explain testing objectives, strategies, and processes
2. CO2: Apply functional and structural test design techniques
3. CO3: Understand levels of testing and perform integration and system testing
4. CO4: Use tools for test automation and defect tracking
5. CO5: Design comprehensive test plans and maintain test documentation
6. CO6: Conduct effective reviews, audits, and quality assurance practices



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Software Testing Principles of testing, Software quality, SDLC vs. STLC, Role of testing in SDLC, Testing myths, Test process and policy Self learning topics: IEEE standards on testing	06	CO1
2	Test Design Techniques Black-box testing: Equivalence partitioning, Boundary value analysis, Decision table, State transition, Use case testing. White-box testing: Statement, branch, path coverage. Self learning topics: Use case testing for login modules	10	CO2
3	Levels and Types of Testing Unit testing, Integration testing (Top-down, Bottom-up), System testing, Acceptance testing. Regression, smoke, sanity, alpha-beta, and usability testing. Self learning topics: Preparing integration test cases	10	CO3
4	Automation Testing Tools Introduction to automation testing, Selenium basics, TestNG framework, Recording and running tests, Script maintenance, Assertions. Self learning topics: Writing Selenium scripts for form validation	10	CO4
5	Test Management and Defect Life Cycle Test planning, Test case documentation, Test data preparation, Defect lifecycle and classification, Bug reporting tools: JIRA, Bugzilla. Self learning topics: Using JIRA for defect logging and tracking	12	CO5
6	Quality Assurance and Reviews Software quality metrics, Quality audits, Review techniques (peer reviews, inspections), Risk-based testing, Code walkthroughs. Self learning topics: Performing checklist-based code review	12	CO6



Text Books:

1. Software Testing Principles and Practices – Srinivasan Desikan, Gopalaswamy Ramesh, Pearson, ISBN: 9788131708989
2. Foundations of Software Testing – Dorothy Graham, Erik van Veenendaal, Pearson, ISBN: 9788131724170

Reference Books:

1. Effective Software Testing – Elfriede Dustin, Addison-Wesley, ISBN: 9780321146533
2. Software Testing: A Craftsman's Approach – Paul C. Jorgensen, CRC Press, ISBN: 9780367332244
3. Selenium Testing Tools Cookbook – Unmesh Gundecha, Packt Publishing, ISBN: 9781784392514

Web References:

1. <https://www.istqb.org>
2. <https://junit.org>
3. <https://www.selenium.dev>
4. <https://www.softwaretestinghelp.com>
5. <https://www.atlassian.com/software/jira>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-21	Technical Writing and Communication for IT Professionals	02	-	-	02	02

Prerequisites:

1. Basic understanding of grammar and sentence construction
2. Familiarity with technical terms used in IT and software development
3. Interest in documentation, writing, and communication

Subject Objectives:

1. Develop technical writing skills specific to the IT domain
2. Learn effective document design and structuring for technical materials
3. Practice writing user manuals, reports, and software documentation
4. Enhance oral and written communication for professional settings
5. Understand the role of documentation in project and product development

Subject Outcome: Learner will be able to

1. CO1: Understand the principles and practices of effective technical writing
2. CO2: Apply techniques to write and organize technical documents for varied audiences
3. CO3: Create documentation such as user guides, technical reports, and white papers
4. CO4: Use documentation tools and templates used in industry
5. CO5: Communicate effectively in workplace scenarios (emails, reports, meetings)
6. CO6: Analyze and improve clarity, coherence, and usability in technical content



Module No.	Detailed Content	Hours	CO Mapping
1	Introduction to Technical Writing Definition, Importance, Objectives, Characteristics of technical communication, Technical vs. Non-technical writing, Role of technical writers in IT. Self learning topics: Examples of poor vs. effective documentation	06	CO1
2	Writing Process and Document Design Planning, Drafting, Revising, Editing, Proofreading. Document formats, layout, font and style guidelines, content organization, visuals and infographics .Self learning topics: Using document style guides	10	CO2
3	Types of Technical Documents User manuals, installation guides, system documentation, release notes, white papers, case studies, API documentation, functional specs. Self learning topics: Mapping document type to user needs	10	CO3
4	Tools and Technologies for Documentation MS Word, Google Docs, Markdown, LaTeX, Snagit, Version control, Wikis, Online Help systems. Basics of content management systems .Self learning topics: Using Markdown and Git for documentation	10	CO4
5	Communication in the IT Workplace Email etiquette, Meeting notes and MoMs, Status reporting, Proposal writing, Communication in project teams, Conflict resolution techniques. Self learning topics: Common communication pitfalls in tech teams	12	CO5
6	Improving Clarity, Usability, and Accessibility Clarity and simplicity, Readability indexes, User-centered design in documentation, Language sensitivity, Accessibility standards (WCAG), Inclusive language. Self learning topics: Revising unclear technical text	12	CO6



Text Books:

1. Technical Communication – Meenakshi Raman & Sangeeta Sharma, Oxford University Press, ISBN: 9780195695747
2. A Guide to Writing as an Engineer – David Beer & David McMurrey, Wiley, ISBN: 9781118300271

Reference Books:

1. Handbook of Technical Writing – Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, Bedford/St. Martin's, ISBN: 9781457675522
2. Developing Quality Technical Information – Gretchen Hargis et al., IBM Press, ISBN: 9780131477490
3. Read Me First! A Style Guide for the Computer Industry – Sun Technical Publications, Prentice Hall, ISBN: 9780131428997

Web References:

1. <https://developers.google.com/style>
2. <https://techwhirl.com>
3. <https://www.w3.org/WAI/standards-guidelines>
4. <https://opensource.com>
5. <https://www.plainlanguage.gov>



Subject Code	Subject Name	Teaching Scheme (Contact Hours 45)			Credits Assigned	
		Theory	Practical	Tutorial	Theory	Total
FY-MCA-S4-22	Capstone Project	08	-	-	08	08

Prerequisites:

1. Successful completion of core programming, design, and database subjects
2. Basic understanding of software project development lifecycle
3. Familiarity with at least one cloud platform or web development framework

Subject Objectives:

1. Provide hands-on experience in designing and developing a complete project
2. Integrate knowledge from multiple subjects to solve real-world problems
3. Apply SDLC principles in a practical environment
4. Foster teamwork, problem-solving, and project management skills
5. Demonstrate outcomes through presentation, report, and deployment

Subject Outcome: Learner will be able to

1. CO1: Define, design, and scope a real-time software/cloud-based project
2. CO2: Apply SDLC practices in planning, development, and testing
3. CO3: Develop and integrate functional components into a full application
4. CO4: Work effectively in teams and maintain project documentation
5. CO5: Demonstrate and deploy a working prototype or final product
6. CO6: Evaluate the effectiveness of solutions through testing and feedback



Module No.	Detailed Content	Hours	CO Mapping
1	Capstone Project Development Project identification and problem definition, requirement analysis, design and technology selection, database and API integration, implementation, testing, deployment. Includes project proposal, planning documents, mid-term demo, final report, and presentation. Self learning topics: Exploring open-source project ideas, identifying community challenges, reading GitHub repositories for inspiration	60	CO1, CO2, CO3, CO4, CO5, CO6

Text Books:

1. Software Engineering – Ian Sommerville, Pearson, ISBN: 9789332582705
2. Agile Project Management with Scrum – Ken Schwaber, Microsoft Press, ISBN: 9780735619933

Reference Books:

1. The Lean Startup – Eric Ries, ISBN: 9780307887894
2. Project Management for the Unofficial Project Manager – Kory Kogon, FranklinCovey, ISBN: 9781941631102
3. Software Project Survival Guide – Steve McConnell, Microsoft Press, ISBN: 9780735605356

Web References:

1. <https://github.com>
2. <https://www.scrum.org>
3. <https://www.atlassian.com/agile>
4. <https://opensource.guide>
5. <https://devpost.com>