

Kurukshetra University, Kurukshetra
(Established by the State Legislature Act XII of 1956)
(‘A++’ Grade, NAAC Accredited)

॥ योगस्थः कुरु कर्माणि ॥
समबुद्धि व योग युक्त होकर कर्म करो
(Perform Actions while Stead fasting in the State of Yoga)



Syllabus of Examination (5th and 6th Semester) for Under-Graduate Programmes
Subject: Computer Applications
according to
Curriculum Framework for Under-Graduate Programmes
As per NEP-2020 (Multiple Entry-Exit, Internships and Choice Based Credit System)
DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
(For the Batches Admitted From 2023-2024)

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	V		
Name of the Course	Data Analytics using SpreadSheets		
Course Code	B23-CAC-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-5/MCC-9		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Basic computer literacy, familiarity with MS Office or Google Workspace, understanding of basic mathematics/statistics concepts		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1.Understand and use spreadsheet tools for data organization and analysis 2.Perform data cleaning, transformation, and statistical operations using spreadsheet functions 3.Create data visualizations to support business decisions 4.Apply spreadsheet-based analytics to real-life problems 5.* Practicals based on data analytics using spreadsheets.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper-Setter</u> The examiner will set a total of nine questions. Out of which, the first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus. The candidate will have to attempt five questions, selecting one from each unit. First			

question will be compulsory.

The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Introduction to Data Analytics using Spreadsheets Definition and scope of data analytics, Types of analytics – descriptive, diagnostic, predictive, prescriptive, Spreadsheet software overview – MS Excel and Google Sheets, Interface and basic operations – sorting, filtering, formatting, Cell referencing – absolute, relative, mixed, Basic formulas – SUM, AVERAGE, COUNT, MIN, MAX, IF	11
II	Data Cleaning and Preparation Handling missing and inconsistent data, Text functions – LEFT, RIGHT, MID, LEN, TRIM, CONCATENATE, TEXTJOIN, Logical functions – IF, AND, OR, NOT, Lookup functions – VLOOKUP, HLOOKUP, XLOOKUP, INDEX, MATCH, Date and time functions, Removing duplicates, data validation, conditional formatting, Flash fill, importing data (CSV, TSV)	11
III	Statistical Analysis using Spreadsheets Descriptive statistics – Mean, Median, Mode, Variance, Standard Deviation, Frequency distributions, Histograms, Charts – bar, pie, line, scatter, Using Pivot Tables and Pivot Charts, Correlation and regression basics, Using Data Analysis ToolPak	11
IV	Applied Analytics and Dashboarding Business case studies – sales, marketing, finance, What-If analysis – Goal Seek, Data Tables, Scenario Manager, Creating dashboards – charts, slicers, pivot tables, Introduction to macros (recording only), Collaborative analytics using Google Sheets, Report generation and export, Ethics in data handling	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Formatting and organizing raw data in Excel • Using basic functions (SUM, AVERAGE, COUNTIF) on sales dataset • Data cleaning using text and logical functions • Using VLOOKUP and INDEX-MATCH for data retrieval • Creating Pivot Tables and Pivot Charts • Conditional formatting for outlier detection • Generating summary statistics with Data Analysis ToolPak • Creating charts to visualize survey data • What-If analysis using Goal Seek and Scenario Manager • Designing a dashboard for monthly sales performance • Create a class called cube with the data members • Importing and preparing CSV data • Recording and executing simple macros	30
Suggested Evaluation Methods		

Internal Assessment: ➤ Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	End-Term Examination: A three-hour exam for both theory and practicum. End Term Exam Marks: 70(50(T)+20(P))
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Exploring Microsoft Excel for Data Analysis by R. Kishore and B. Sinha • Data Analysis Using Microsoft Excel by Michael R. Middleton • Excel 2021 Bible by Michael Alexander • Google Workspace Documentation • NPTEL/Coursera Excel Courses,	

*Applicable for courses having practical components.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
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Scheme: 2023-24, Syllabus: 2025-26			
Part A – Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	V		
Name of the Course	Computer Networks		
Course Code	B23-CAC-502		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-10		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Basic knowledge of computer systems and operating systems		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1.Explain the principles of data communication and networking 2.Compare network models and protocols (OSI, TCP/IP) 3.Analyze various routing and switching techniques 4.Configure and troubleshoot basic networks 5.* Demonstrate practical knowledge of IP addressing and subnetting.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			
Examiner will set a total of nine questions. Out of which first question will be compulsory Remaining eight questions will be set from four unit selecting two questions from each unit Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus. Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory. Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.			
Unit	Topics		Contact Hours

I	Introduction to Computer Networks and Models Definition and uses of computer networks, Types of networks – LAN, MAN, WAN, PAN, Network topologies – bus, star, ring, mesh, hybrid, Network devices – hub, switch, router, bridge, Network architecture – client-server, peer-to-peer, Network reference models – OSI and TCP/IP, Layers and their functions, Encapsulation and decapsulation process	11
II	Data Communication and Transmission Media Analog vs digital signals, Transmission modes – simplex, half duplex, full duplex, Encoding and modulation techniques, Transmission media – guided (twisted pair, coaxial, fiber optic), unguided (radio, microwave, infrared), Bandwidth, attenuation, latency, multiplexing – FDM, TDM, WDM, Error detection and correction – parity, CRC, Hamming code	11
III	Internetworking, Addressing and Routing IP addressing – IPv4 and IPv6, classes, static and dynamic addressing, Subnetting and supernetting, Introduction to DNS and DHCP, Routing concepts – static vs dynamic routing, Distance vector and link state routing, Routing protocols – RIP, OSPF, BGP, Switching techniques – circuit switching, packet switching, virtual circuit	11
IV	Transport Layer, Application Layer and Network Security Transport layer protocols – TCP and UDP, Flow control and error control mechanisms, Application layer protocols – HTTP, FTP, SMTP, POP, IMAP, DNS, Network security fundamentals – threats, attacks, firewalls, encryption, digital signatures, SSL/TLS basics, Introduction to network simulation tools (e.g., Cisco Packet Tracer, Wireshark), Emerging trends – IoT networking, mobile networks	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Identify and compare different types of network topologies using simulation tools • Setup a small peer-to-peer and client-server network • Configure IP addressing (manual and DHCP) • Perform subnetting and VLSM exercises • Configure and verify static routing between routers • Simulate packet flow using Cisco Packet Tracer • Use Wireshark to capture and analyze network packets • Implement DNS and HTTP communication in a network simulation • Demonstrate basic firewall rules in simulation • Simulate basic encryption and decryption techniques • Configure NAT and port forwarding • Study of wireless network setup and security configuration	30
Suggested Evaluation Methods		

Internal Assessment: ➤ Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	End-Term Examination: A three-hour exam for both theory and practicum. End Term Exam Marks: 70(50(T)+20(P))
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Computer Networking: A Top-Down Approach by Kurose and Ross • Data Communications and Networking by Behrouz A. Forouzan • Computer Networks by Andrew S. Tanenbaum • Cisco Networking Academy Resources • NPTEL Video Lectures on Computer Networks,	

*Applicable for courses having practical components.

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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	V		
Name of the Course	Foundations of Server-Side Development		
Course Code	B23-CAC-503		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Basic knowledge of programming, familiarity with HTML, CSS, and client-side scripting, understanding of HTTP protocol and web browsers.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the architecture and components of server-side web applications 2. Build and manage RESTful APIs 3. Develop backend logic using a server-side language 4. Implement CRUD operations with a database 5. * Practicals based on Server-Side Development.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
Instructions for Paper- Setter			
Unit	Topics		Contact Hours
I	Introduction to Server-Side Development Client-server architecture, Static vs dynamic web pages, Role of server-side scripting, Overview of HTTP protocol, request-response cycle, Introduction to server-side platforms –		11

	Node.js, Express.js, Setting up a development environment, Writing your first server application, Understanding ports and localhost	
II	Routing, Middleware, and API Development Defining routes and HTTP methods (GET, POST, PUT, DELETE), Route parameters and query strings, Introduction to RESTful APIs, Working with JSON data, Understanding middleware – request, response, next, Error handling middleware, Building modular route handlers	11
III	Working with Databases and CRUD Operations Connecting to databases – MongoDB, MySQL, Performing CRUD operations – Create, Read, Update, Delete, Schema design and validation, Using ORM/ODM – Mongoose (for MongoDB) or Sequelize (for SQL), Query optimization and security, Handling file uploads and form data	11
IV	Session Management, Authentication, and Deployment Session vs token-based authentication, Using cookies, sessions, and JWT, User authentication and authorization (signup, login, logout), Securing APIs and handling CORS, Introduction to HTTPS and SSL, Deploying applications – local server, Logging, debugging, and performance monitoring	12
V*	The following activities be carried out/ discussed in the lab during the initial period of the semester. Programming Lab: • Set up a basic server using Node.js • Create routes for handling different HTTP methods • Develop a RESTful API to manage user data • Implement middleware for logging and error handling • Build a form handler that stores data to a database • Perform CRUD operations using MongoDB or MySQL • Develop user registration and login functionality, Use JWT for secure authentication • Handle file uploads and form validations • Use Postman to test REST APIs • Secure routes using middleware and authentication	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.:4 • Mid-Term Exam: 7 ➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:5 • Mid-Term Exam: NA		End Term Examination: A three-hour exam for both theory and practicum.

Part C-Learning Resources
Recommended Books/e-resources/LMS: • Web Development with Node and Express by Ethan Brown • Server-Side Web Development with Node.js and Express by Andrew Mead (Online) • Learning Web App Development by Semmy Purewal • Full Stack Open (open-source curriculum) • NPTEL/Digital India resources on backend web development,

*Applicable for courses having practical component.

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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	V		
Name of the Course	Cloud Computing		
Course Code	B23-CAC-504		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Basic knowledge of computer networks, operating systems, and internet usage.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the fundamentals and evolution of cloud computing. 2. Identify cloud service models and deployment models. 3. Explore virtualization and its role in cloud architecture. 4. Use cloud services and tools such as AWS, Google Cloud, or Azure. 5. * Deploy simple applications on cloud platforms. Demonstrate understanding of security and management in cloud environments.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Instructions for Paper-Setter Examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus. The candidate must attempt five questions in all, selecting one question from each unit. First question will be compulsory. Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.			

Part B- Contents of the Course		
Unit	Topics	Contact Hours
I	Introduction to Cloud Computing: Definition and characteristics of cloud computing, Evolution of cloud computing, Advantages and challenges of cloud computing, Cloud architecture, Service models: IaaS, PaaS, SaaS, Deployment models: Public, Private, Hybrid, and Community Cloud, Use cases of cloud computing	11
II	Virtualization in Cloud: Definition and benefits of virtualization, Types of virtualization: Hardware, OS, Server, Storage, Virtual Machines (VMs), Hypervisors: Type 1 and Type 2, Role of virtualization in cloud computing, VM provisioning and management	11
III	Cloud Service Providers and Tools: Introduction to major cloud platforms: AWS, Google Cloud, Microsoft Azure, Creating and managing cloud accounts, Cloud storage services: S3, Google Drive, Azure Blob, Deploying basic applications on cloud (e.g., web servers), Introduction to containers: Docker and Kubernetes	11
IV	Security, Management, and Future Trends: Cloud security fundamentals: data privacy, authentication, encryption, Identity and Access Management (IAM), Cloud service level agreements (SLAs), Cloud monitoring and billing, Green computing and cloud, Emerging trends: Edge computing, Serverless computing	12
V*	The following activities be carried out/ discussed in the lab during the semester. Programming Lab: • Create an account on AWS/Google Cloud/Azure • Launch and manage a Virtual Machine (VM) instance • Deploy a static website using cloud storage (e.g., AWS S3) • Create and configure cloud storage buckets • Install and run a basic container using Docker • Explore IAM roles and permissions • Monitor usage and generate billing reports • Deploy a simple application using serverless architecture (e.g., AWS Lambda)	30
Suggested Evaluation Methods		
Internal Assessment: > Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10		End Term Examination: A three-hour exam for both theory and practicum. End Term Exam

➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	Marks: 70(50(T)+20(P))
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Cloud Computing: Concepts, Technology & Architecture by Thomas Erl • Cloud Computing: A Practical Approach by Anthony T. Velte, Toby J. Velte, Robert Elsenpeter • Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi • Learning Cloud Computing by Alok Shrivastwa, Packt Publishing	

*Applicable for courses having practical components.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	V		
Name of the Course	Java Based Web App Development		
Course Code	B23-CAC-505		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-3		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Basic knowledge of Java programming, HTML, CSS, and databases.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the architecture of Java web applications. 2. Develop dynamic websites using Java Servlets and JSP. 3. Handle form data, session, and cookies in web applications. 4. Integrate databases using JDBC for CRUD operations. 5. * Deploy and test Java-based web applications on web servers like Apache Tomcat.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> The examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus. Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory. Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.			
Unit	Topics		Contact Hours

I	Basics of Web Development and Java EE Architecture: Overview of web development, Introduction to Java EE architecture, HTTP basics and request-response cycle, Java web application structure, Introduction to Apache Tomcat server, Setting up a development environment (Eclipse/NetBeans + Tomcat)	11
II	Servlets Programming: Servlet lifecycle, Creating and deploying servlets, Handling request and response (GET and POST methods), Session tracking: Cookies, URL rewriting, HttpSession, ServletConfig and ServletContext, Exception handling and filters in servlets	11
III	JavaServer Pages (JSP): Introduction to JSP, JSP lifecycle, JSP elements: declarations, scriptlets, expressions, directives, and standard actions, JSP implicit objects, JSP with JavaBeans, Model-View-Controller (MVC) architecture in Java web apps	11
IV	Database Connectivity and Web App Deployment: JDBC overview and architecture, Connecting to databases using JDBC, Performing CRUD operations, Connection pooling, Error handling in JDBC, Deploying web apps using WAR files, Security basics in Java web apps	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Setup and configure Apache Tomcat server • Create and deploy a basic servlet application • Handle form submission using GET and POST in servlets • Implement session tracking using cookies and HttpSession • Create a dynamic JSP page with embedded Java code • Connect a JSP/Servlet app to a MySQL database using JDBC • Perform CRUD operations (Create, Read, Update, Delete) using JDBC • Package and deploy the web application as a WAR file • Use MVC design pattern to build a login application	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA		End-Term Examination: A three-hour exam for both theory and practicum. End Term Exam Marks: 70(50(T)+20(P))
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

- Seymour Lipschutz, Data Structures, Tata McGraw- Hill Publishing Company Limited, Schaum's Outlines.
- Yedidyan Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, Data Structures Using C, Pearson Education.
- Trembley, J.P. And Sorenson P.G., An Introduction to Data Structures with Applications, McGraw-Hill.
- Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Addison- Wesley.

* Applicable for courses having practical components.

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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	V		
Name of the Course	Programming in R		
Course Code	B23-CAC-506		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/ VAC)	DSE-3		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Basic knowledge of statistics, programming fundamentals, and data structures.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the fundamentals of R programming language. 2. Write and debug R programs for data analysis. 3. Work with data frames, lists, and control structures in R. 4. Apply statistical functions and data visualization techniques. 5. *Perform data wrangling and exploratory data analysis using R.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus. Candidate will have to attempt five questions in all, selecting one question from each unit. First			

question will be compulsory. Practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.		
Unit	Topics	Contact Hours
I	Introduction to R and RStudio: Installing R and RStudio, R as a calculator, variables and data types, R scripts and console, R packages and libraries, Basic I/O operations, Basic functions in R	11
II	Data Structures and Control Flow: Vectors, matrices, arrays, lists, data frames, factors, Type coercion and indexing, Conditional statements: if, else, switch, Looping: for, while, repeat, Apply family of functions (apply, lapply, sapply)	11
III	Data Manipulation and Visualization: Reading and writing data (CSV, Excel, TXT), Data cleaning and preprocessing using dplyr, Filtering, selecting, mutating, summarising data, Data visualization using ggplot2, Histograms, bar charts, scatter plots, box plots, Handling missing data	11
IV	Statistical Analysis and R for Data Science: Descriptive statistics: mean, median, mode, variance, Standard deviation and correlation, Hypothesis testing: t-test, chi-square, ANOVA, Introduction to linear regression, Introduction to R for machine learning and data science (overview), Project: exploratory data analysis on real-world dataset	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Install and set up R and RStudio • Write R scripts using basic data types and operators • Create and manipulate vectors, matrices, and data frames • Implement control structures and functions in R • Load and clean data using read.csv() and dplyr functions • Create visualizations using ggplot2 (bar, line, scatter, histogram) • Perform basic statistical analysis using in-built R functions • Conduct hypothesis testing using t-test and chi-square test • Build a simple linear regression model • Mini-project: Exploratory data analysis on a real dataset (e.g., COVID-19, sales, population)	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10		End Term Examination: A three-hour exam for both theory and

➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	practicum.
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • The Art of R Programming by Norman Matloff • R for Data Science by Hadley Wickham and Garrett Grolemund • Hands-On Programming with R by Garrett Grolemund • Beginning R: The Statistical Programming Language by Mark Gardener • Practical Data Science with R by Nina Zumel and John Mount	

*Applicable for courses having practical components.

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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	VI		
Name of the Course	Artificial Intelligence		
Course Code	B23-CAC-601		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-6/MCC-11		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Basic knowledge of Python programming, data structures, logic and algorithms.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the fundamentals, scope, and goals of artificial intelligence. 2. Apply various AI problem-solving techniques including search strategies. 3. Implement basic AI algorithms such as heuristic search, game playing, and knowledge representation. 4. Explore machine learning foundations and rule-based expert systems. 5. *Develop simple AI applications using Python-based AI libraries.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper-Setter</u> The examiner will set a total of nine questions. Out of which the first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus. The candidate will have to attempt five questions in all, selecting one question from each unit. The first question will be compulsory.			

The practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Introduction to Artificial Intelligence: Definition and scope of AI, History and evolution of AI, Applications of AI in various domains, Intelligent agents, types and structure of agents, Concept of environment and rationality, Turing test and limitations of AI	11
II	Problem Solving and Search Strategies: Problem formulation, State space representation, Uninformed search: Breadth-first, Depth-first, Uniform cost, Informed search: Greedy, A* algorithm, Heuristic functions, Local search: Hill climbing, Simulated annealing, Game playing: Minimax algorithm, Alpha-beta pruning	11
III	Knowledge Representation and Reasoning: Knowledge representation techniques: propositional logic, predicate logic, semantic networks, frames, Production rules, Inference techniques, Forward and backward chaining, Rule-based expert systems and architecture, Handling uncertainty: Bayesian reasoning, Fuzzy logic	11
IV	Introduction to Machine Learning and AI Tools: Basic concepts of machine learning: supervised, unsupervised learning, Introduction to decision trees, regression and clustering, Introduction to AI libraries: NumPy, Pandas, Real-life applications: chatbots, recommender systems, virtual assistants	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Implement a simple chatbot using rule-based logic • Develop Python programs for uninformed and informed search algorithms • Write a program for the Minimax algorithm with alpha-beta pruning • Design and evaluate a simple expert system using rules • Perform classification using k-NN or logistic regression • Use fuzzy logic for a basic decision-making system • Create a recommendation engine using collaborative filtering	30
Suggested Evaluation Methods		

Internal Assessment: ➤ Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	End-Term Examination: A three-hour exam for both theory and practicum. End Term Exam Marks: 70(50(T)+20(P))
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig • Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B. Nair • Introduction to Artificial Intelligence by Wolfgang Ertel • Python Machine Learning by Sebastian Raschka • Artificial Intelligence with Python by Prateek Joshi	

*Applicable for courses having practical components.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	VI		
Name of the Course	Advanced Web Development Techniques		
Course Code	B23-CAC-602		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/ VAC)	MCC-12		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Basic knowledge of HTML, CSS, JavaScript, and introductory web development (including client-server concepts).		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Develop dynamic, interactive, and responsive websites using modern frameworks. 2. Implement AJAX-based interactions and API integrations. 3. Utilize JavaScript frameworks and state management techniques. 4. Build and deploy full-stack applications using best practices. 5. *Practicals based on Advanced Web Development techniques.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question			

will comprise of short answer type questions covering entire syllabus.
Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory.
Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Responsive and Modern Frontend Development: Advanced HTML5 and CSS3 features, Responsive design using media queries and Flexbox/Grid, CSS pre-processors, JavaScript ES6+ features, DOM manipulation and event handling, Introduction to frontend frameworks (React/Angular)	11
II	JavaScript Frameworks and State Management: Component-based architecture (React), Props and state, Conditional rendering, Routing using React Router, State management using Redux, Handling forms and validation	11
III	Asynchronous Web and API Integration: AJAX and Fetch API, Consuming RESTful APIs, Promises and async/await, Error handling in asynchronous calls, CORS and JSON Web Tokens (JWT), WebSockets and real-time communication basics	11
IV	Full Stack Development and Deployment: Introduction to Node.js and Express.js, Connecting frontend with backend APIs, Introduction to MongoDB or MySQL, CRUD operations in full stack apps, Application security (XSS, CSRF, HTTPS, authentication), Deployment on platforms	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Design a responsive website layout using Flexbox and media queries • Build an interactive UI with React components • Implement client-side routing and dynamic navigation • Create and validate forms using modern JavaScript • Fetch and display data from a public API using async/await • Handle real-time data using WebSockets or polling techniques • Develop a full-stack CRUD app using React + Node.js + MongoDB/MySQL • Implement user authentication with JWT and protected routes • Secure a web application from common vulnerabilities	30
Suggested Evaluation Methods		
Internal Assessment: > Theory • Class Participation: 5		End Term Examination: A three hour

• Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	exam for both theory and practicum.
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Eloquent JavaScript by Marijn Haverbeke • Learning React by Alex Banks and Eve Porcello • Full-Stack React Projects by Shama Hoque • Web Development with Node and Express by Ethan Brown • Pro MERN Stack by Vasan Subramanian	

*Applicable for courses having practical component.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	VI		
Name of the Course	Developing Modern Web Applications using React		
Course Code	B23-CAC-603		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/ VAC)	DSE-4		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Proficiency in HTML, CSS, JavaScript (ES6+), and basic understanding of web development and DOM.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the fundamentals of React and component-based architecture. 2. Develop interactive and dynamic front-end applications using React. 3. Manage application state and routing effectively. 4. Integrate RESTful APIs and perform asynchronous operations. 5. *Build, test, and deploy modern single-page applications (SPAs).		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus. Candidate will have to attempt five questions in all, selecting one question from each unit. First			

question will be compulsory.

Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Introduction to React and Component Architecture: Introduction to SPA and React ecosystem, Setting up React development environment using Create React App (CRA), JSX syntax and rendering elements, Components: class-based vs functional, Props and state, Event handling in React, React Developer Tools	11
II	React State Management and Lifecycle: Component lifecycle methods, useState and useEffect hooks, Lifting state up, Conditional rendering, Controlled and uncontrolled components, Forms handling and validation, Context API for global state	11
III	React Routing and API Integration: React Router: navigation, route parameters, nested routing, Programmatic navigation, Introduction to Axios and Fetch API, Making GET and POST requests, Handling async/await and Promises, Error boundaries and loading states	11
IV	Application Development and Deployment: Project structuring and reusable components, State management using Redux (basic concepts), Custom hooks and composition, Building and testing React apps, Deployment using Netlify/GitHub Pages, Best practices and performance optimization	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Set up a React project using Create React App • Create functional components and use props and state • Build an interactive form with validation • Implement state management using React hooks • Build a multipage SPA using React Router • Fetch data from a REST API and render it dynamically • Handle loading and error states in data fetching • Use Context API for managing global state • Create and use custom hooks • Deploy a complete React application to Netlify	30
Suggested Evaluation Methods		
Internal Assessment: > Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10		End Term Examination: A three hour exam for both theory and

➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	practicum.
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Learning React by Alex Banks and Eve Porcello • React Up and Running by Stoyan Stefanov • Fullstack React by Accomazzo, Murray, Lerner et al. • The Road to React by Robin Wieruch • React – The Complete Guide (Udemy Course) by Maximilian Schwarzmüller	

*Applicable for courses having practical component.

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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	VI		
Name of the Course	Data Storage Technologies and Networks using AWS		
Course Code	B23-CAC-604		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/ VAC)	DSE-4		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Basic knowledge of cloud computing, computer networks, and Linux/Windows OS.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand fundamental concepts of data storage technologies and network infrastructure. 2. Explore AWS storage services like S3, EBS, and Glacier. 3. Configure virtual private cloud (VPC) and networking components in AWS. 4. Implement secure and scalable storage and networking solutions. 5. *Monitor, manage, and optimize storage and network resources on AWS.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus.			

Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory.

Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Introduction to Data Storage Technologies: Types of storage: primary, secondary, online, offline, Overview of traditional vs cloud-based storage, File systems and storage architectures: DAS, NAS, SAN, RAID levels and data redundancy, Backup and archival concepts, Storage performance metrics	11
II	AWS Storage Services: Overview of AWS storage solutions, Amazon S3: buckets, objects, lifecycle policies, permissions, Versioning and cross-region replication, Amazon EBS: volumes, snapshots, and backups, Amazon EFS: file storage for EC2, Amazon Glacier: archival storage and retrieval policies	11
III	Network Fundamentals and AWS Networking: Basics of computer networks: LAN, WAN, IP addressing, DNS, Subnetting, Cloud networking principles, AWS VPC: subnets, route tables, internet gateways, NAT, security groups, Elastic IPs and endpoints, Connecting EC2 instances securely within VPC	11
IV	Storage-Network Integration and Security on AWS: Attaching storage to EC2, Data transfer services (AWS DataSync, Snowball), Monitoring storage and network using AWS CloudWatch, Cost estimation and optimization tools (AWS Pricing Calculator), Identity and Access Management (IAM) for storage and network, Security best practices for storage and network design	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Create and configure S3 buckets with versioning and permissions • Upload, retrieve, and manage objects using AWS CLI and S3 • Create and attach EBS volumes to EC2 instances • Set up and test lifecycle policies in S3 • Implement file sharing using Amazon EFS • Launch EC2 instances in a custom VPC with subnets and route tables • Configure security groups and network ACLs for VPC • Use AWS CloudWatch to monitor storage and network activity • Perform cross-region replication of an S3 bucket • Estimate and analyze AWS storage and networking costs using pricing tools	30
Suggested Evaluation Methods		

Internal Assessment: ➤ Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	End Term Examination: A three hour exam for both theory and practicum.
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • AWS Certified Solutions Architect Official Study Guide by Joe Baron et al. • Cloud Storage Forensics by Darren Quick • Amazon Web Services in Action by Michael Wittig and Andreas Wittig • Cloud Computing: Concepts, Technology & Architecture by Thomas Erl • Networking Fundamentals by Richard M. Roberts	

*Applicable for courses having practical component.

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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	VI		
Name of the Course	Data Analytics using Python		
Course Code	B23-CAC-606		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/ VAC)	DSE-5		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Basic knowledge of Python programming, statistics, and data structures.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the role of Python in data analytics. 2. Perform data cleaning, transformation, and analysis using Python libraries. 3. Visualize data using Python’s visualization tools. 4. Apply statistical techniques and generate insights from data. 5. *Work with real-world datasets and communicate findings effectively.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus. Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory.			

Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Introduction to Data Analytics and Python Basics: Overview of data analytics and its importance, Python installation and environment setup, Jupyter Notebook and IDEs, Data types, variables, operators, control statements, Functions and modules, File handling	11
II	Working with Data Using NumPy and Pandas: Introduction to NumPy: arrays, indexing, slicing, array operations, Introduction to Pandas: Series and DataFrames, Reading and writing data (CSV, Excel), Data selection, filtering, sorting, and aggregation, Handling missing data and duplicates	11
III	Data Visualization and Exploratory Data Analysis: Introduction to Matplotlib and Seaborn, Line, bar, pie, histogram, scatter, and box plots, Customizing plots and labels, Exploratory Data Analysis (EDA): identifying patterns and anomalies, Correlation and trend analysis	11
IV	Statistical Analysis and Mini Project: Descriptive statistics: mean, median, mode, std deviation, Inferential statistics: hypothesis testing, t-tests, chi-square, Introduction to linear regression, Real-world case study and mini-project using dataset (e.g., sales, weather, education, health), Report generation and dashboard basics using libraries	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Set up Python and Jupyter Notebook environment • Write Python programs for data manipulation using lists and dictionaries • Create and operate on NumPy arrays • Load, clean, and explore datasets using Pandas • Handle missing data and perform group-wise analysis • Visualize data using Matplotlib and Seaborn • Perform correlation analysis and plot heatmaps • Apply basic statistical techniques on datasets	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: NA		End Term Examination: A three hour exam for both theory and practicum.

• Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Python for Data Analysis by Wes McKinney • Data Science from Scratch by Joel Grus • Think Stats by Allen B. Downey • Practical Statistics for Data Scientists by Peter Bruce and Andrew Bruce • Hands-On Data Analysis with Pandas by Stefanie Molin	

*Applicable for courses having practical component.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
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Scheme: 2023-24, Syllabus: 2025-26			
Part A - Introduction			
Subject	COMPUTER APPLICATIONS		
Semester	VI		
Name of the Course	Data Analytics using R		
Course Code	B23-CAC-607		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-5		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Basic knowledge of statistics, programming concepts, and spreadsheet operations.		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the fundamentals of R programming for data analysis. 2. Perform data import, manipulation, and cleaning using R. 3. Visualize and interpret datasets using appropriate R libraries. 4. Apply statistical techniques to draw insights from data. 5. *Execute data-driven projects using real-world datasets.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))		Time: 3 Hrs.(T), 3Hrs.(P)	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus.			

Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory.

Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Introduction to R Programming and Data Types: Installing and setting up R and RStudio, R syntax and operators, Variables and data types (numeric, character, logical, factor), Vectors, matrices, lists, and data frames, Writing and using functions, control structures (if, else, for, while), Importing and exporting data (CSV, Excel, TXT)	11
II	Data Wrangling and Manipulation with dplyr and tidyr: Data selection, filtering, arranging, and mutating with dplyr, Summarization and grouping data, Joining datasets, Handling missing data, Reshaping data using tidyr (gather, spread, unite, separate), Working with categorical data and date-time	11
III	Data Visualization using ggplot2 and Exploratory Data Analysis (EDA): Introduction to data visualization, Plot types: bar, histogram, boxplot, line, scatterplot, Customizing graphs (labels, colors, legends), ggplot2 grammar of graphics, Exploring relationships and distributions, Basic correlation analysis and visual diagnostics	11
IV	Statistical Techniques and Case Study: Descriptive statistics: mean, median, variance, std dev, Inferential statistics: t-test, chi-square, ANOVA, Introduction to regression analysis, Basic clustering and classification overview, Final case study using real dataset (healthcare, finance, education, etc.), Report generation using R Markdown	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Set up RStudio and execute basic R commands • Work with vectors, lists, data frames, and matrices • Load and clean data using readr, dplyr, and tidyr • Perform data filtering, sorting, and aggregation • Handle missing and inconsistent data • Visualize data using ggplot2 (scatter, bar, box, histogram) • Conduct correlation and summary statistics • Perform hypothesis testing (t-test, chi-square) • Run a simple linear regression in R	30
Suggested Evaluation Methods		
Internal Assessment:		End Term

➤ Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	Examination: A three hour exam for both theory and practicum.
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • R for Data Science by Hadley Wickham and Garrett Grolemund • The Art of R Programming by Norman Matloff • Hands-On Programming with R by Garrett Grolemund • Practical Data Science with R by Nina Zumel and John Mount • Data Analytics with R by Bharti Motwani	

*Applicable for courses having practical component.