AC: 02.06.2025 ITEM NO: 1.3

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for
Program: Bachelor of Science
Course: T.Y.B.Sc.
Subject: Computer Science

with effect from
Academic Year 2025-2026

PROGRAM OUTCOMES

PO	Description
A student completing Bachelor's Degree in **Science** Program will be able to	
PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate Programme. Execute strong theoretical and practical understanding generated from the specific graduate Programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions
PO3	Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibit thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

Year of implementation- 2025-2026

Name of the Department-Computer Science

SEM	Course Code	Course Title	Vertical	Credit
V	25CSMJ511	ARTIFICIAL INTELLIGENCE	Major	2
	25CSMJP51	ARTIFICIAL INTELLIGENCE (P)	Major	2
	25CSMJ512	DATA COMMUNICATION & NETWORKING	Major	2
	25CSMJP52	DATA COMMUNICATION & NETWORKING (P)	Major	2
	25CSMJ513	RESEARCH METHODOLOGY	Major	2
	25CSEL513	ADVANCE JAVA	Elective	2
	25CSELP53	ADVANCE JAVA (P)	Elective	2
	25CSEL514	CYBER FORENSIC	Elective	2
	25CSELP54	CYBER FORENSIC (P)	Elective	2
	25CSMR521	SOFTWARE TESTING & QUALITY ASSURANCE	Minor	2
	25CSMRP51	SOFTWARE TESTING & QUALITY ASSURANCE(P)	Minor	2
	25CSVSP51	GAME PROGRAMMING (P)	VOC	2
	25CSFP5	FIELD PROJECT	FP	2
VI	25CSMJ611	DATA SCIENCE	Major	2
	25CSMJP61	DATA SCIENCE (P)	Major	2
	25CSMJ612	CLOUD COMPUTING	Major	2
	25CSMJP62	CLOUD COMPUTING (P)	Major	2
	25CSMJ613	CYBER LAW AND IPR	Major	2
	25CSEL614	ETHICAL HACKING	Elective	2
	25CSELP64	ETHICAL HACKING (P)	Elective	2
	25CSEL615	INFORMATION AND NETWORK SECURITY	Elective	2
	25CSELP65	INFORMATION AND NETWORK SECURITY (P)	Elective	2
	25CSMR621	DATA WAREHOUSE	Minor	2
	25CSMRP61	DATA WAREHOUSE (P)	Minor	2
	25CSOJT6	OJT	OJT	4

SEMESTER-V

Course Code	MAJOR SEM – V	Credits	Lectures/ Week
25CSMJ511	Paper I – ARTIFICIAL INTELLIGENCE	2	2

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Memorize the foundations of AI and Machine learning.
- CO2: Learn about intelligent agents,their environments,the structure of agents,problem solving and Machine learning techniques.
- CO3: Demonstrate knowledge of the foundations and key concepts in the field of AI and Machine learning.
- CO4: Compare and Contrast the searching techniques in AI and evaluate the performance of Machine learning techniques.

Unit	Topics	No of Lectures
I	**What Is AI:** Foundations, History and State of the Art of AI Intelligent Agents: Agents and Environments, Nature of Environments, Structure of Agents.Problem Solving by searching: Problem-Solving Agents, Uninformed Search Strategies, Informed (Heuristic) Search Strategies **Learning :** Forms of Learning, Parametric & Non-Parametric Models.Techniques for evaluating model performance: accuracy, precision, recall, F1-score, Confusion matrix and ROC curve analysis, Cross-validation: k-fold Cross-validation, stratified cross-validation, Hyperparameter tuning and model selection **Supervised Learning** Classification, Regression,Support Vector Machine, Ensemble,K-NN,Naive Bayes Classifier	15
II	**Unsupervised Learning:** Association Rule Mining **Reinforcement learning:** Learning from rewards,Passive Reinforcement Learning,Active Reinforcement Learning, Generalization in Reinforcement Learning,Policy Search,apprenticeship and inverse reinforcement learning **Artificial Neural Networks:** Basics of Neural Network, Biological Neural Network,What is ANN,Types of activation functions,Architecture : Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks.Perceptron Learning Algorithm,Backpropagation, Gradient Descent.	15

Textbooks:

- Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 4th Edition, Pearson, 2022
- Artificial Intelligence, Kevin Knight and Elaine Rich, 3rd Edition, 2017)

Additional References:

- Artificial Intelligence: Foundations of Computational Agents, David L Poole,Alan K. Mackworth, 2nd Edition, Cambridge University Press ,2017
- The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani and Jerome Friedman, Springer, 2013
- Neural Networks A Classroom Approach -Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition.

Course Code	MAJOR SEM-V Practical	Credits	Lectures/Week
25CSMJP51	ARTIFICIAL INTELLIGENCE (P)	2	4

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Memorize the fundamentals of Problem solving and machine learning techniques.
- CO2: Summarize the problem-solving techniques and machine learning algorithms to find solutions to different types of problems.
- CO3: Implement problem solving and machine learning techniques.
- CO4: Compare and Contrast the performance of searching and machine learning techniques

1	Breadth First Search & Iterative Depth First Search ● Implement the Breadth First Search algorithm to solve a given problem. ● Implement the Iterative Depth First Search algorithm to solve the same problem. ● Compare the performance and efficiency of both algorithms.
2	Greedy Best First Search & A star. ● Implement the Greedy Best First Search algorithm to solve a given problem. ● Implement the A star Search algorithm to solve the same problem. ● Compare the performance and efficiency of both algorithms.
3	Support Vector Machines (SVM) ● Implement the SVM algorithm for binary classification. ● Train an SVM model using a given dataset and optimize its parameters. ● Evaluate the performance of the SVM model on test data and analyze the results.
4	Naive Bayes' Classifier ● Implement the Naive Bayes' algorithm for classification. ● Train a Naive Bayes' model using a given dataset and calculate class probabilities. ● Evaluate the accuracy of the model on test data and analyze the results
5	Adaboost Ensemble Learning ● Implement the Adaboost algorithm to create an ensemble of weak classifiers. ● Train the ensemble model on a given dataset and evaluate its performance. ● Compare the results with individual weak classifiers.
6	K-Nearest Neighbors (K-NN)

	• Implement the K-NN algorithm. • Apply the K-NN algorithm to a given dataset and predict the class or value for test data. • • Evaluate the accuracy or error of the predictions and analyze the results.
7	Association Rule Mining • Implement Association Rule Mining algorithm • Find rules that will predict the occurrence of an item based on the occurrences of other items in the transaction
8	Reinforcement Learning • Design the game • Define the rules of the game dictate the penalties and rewards. • Visualize the agents progress
9	Simple Neural Network • Design a simple Neural Network Model with two layers capable of solving a linear classification problem. • Implement Feed Forward Neural Network.
10	Perceptron Learning algorithm • Initialize Perceptron with appropriate input size • Train the Model with fit() over 100 epochs • Predict on test data and evaluate accuracy by comparing predictions with actual labels

Course Code	**MAJOR SEM – V**	**Credits**	**Lectures/Week**
25CSMJ512	**DATA COMMUNICATION AND NETWORKING**	**2**	**2**
Course Outcomes: After successful completion of this course, students would be able to • CO1: Recall basic networking concepts, terminologies, and devices such as network types, topologies, protocols, OSI and TCP/IP models, and fundamental data communication elements. • CO2:Explain the functions of various layers and protocols in computer networks, including data communication techniques, switching methods, and access mechanisms. • CO3:Articulate networking and communication techniques to solve basic numerical and practical problems. • CO4:Compare and evaluate network functions, protocols, and devices for effective communication.			

Unit	Topics	No of Lectures
I	**Introduction to Computer Networks and Networking Elements:** Network Definition, Network Topologies, Network Classifications, Network Protocol, Layered Network Architecture, Overview of OSI Reference Model, Overview of TCP/IP Protocol Suite, Hub, Switch (Managed and Unmanaged), Routers. **Data Communication Fundamentals and Techniques:** Analog and Digital Signal, Data-Rate Limits, Digital to Digital Line Encoding Schemes, Pulse Code Modulation, Parallel and Serial Transmission, Digital to Analog Modulation -Multiplexing Techniques- FDM, TDM, Transmission Media. **Networks Switching Techniques and Access Mechanisms:** Circuit Switching, Packet Switching- Connectionless Datagram Switching, ConnectionOriented Virtual Circuit Switching; Dial-Up Modems, Digital Subscriber Line, Cable TV for Data Transfer.	**15**
II	**Data Link Layer Functions and Protocol:** Error Detection and Error Correction Techniques, Data-Link Control- Framing and Flow Control, Error Recovery Protocols-Stop and Wait ARQ, Go-Back-N ARQ, Point to Point Protocol on Internet. **Multiple Access Protocol and Network Layer:** CSMA/CD Protocols, Ethernet LANS; Connecting LAN and Back-Bone Networks- Repeaters, Hubs, Switches, Bridges, Router and Gateways, Networks Layer Functions and Protocols Routing, Routing Algorithms, Network Layer Protocol of Internet - IP Protocol, Internet Control Protocols. **Transport Layer and Application Layer Functions and Protocols:** Transport Services- Error and Flow Control, Connection Establishment and Release- Three Way Handshake, Overview of Application Layer Protocol. Overview of DNS Protocol; Overview of WWW & HTTP Protocol.	**15**
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Textbooks:

- B. A. Forouzan: Data Communications and Networking, Fourth edition, THM Publishing Company Ltd

Additional References:

- A. S. Tanenbaum: Computer Networks, Fourth edition, PHI Pvt
- Data and Computer Communication, William Stallings, PHI

Course Code	MAJOR SEM-V Practical	Credits	Lectures/Week
25CSMJP52	**DATA COMMUNICATION AND NETWORKING (P)**	**2**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall basic networking hardware, cable types, connectors, and commonly used networking commands.
- CO2: Explain the roles of networking components and IP addressing in building and managing computer networks.
- CO3: Build and configure small wired and wireless networks using suitable tools and devices.
- CO4: Analyze network performance and communication using commands and tools

1	Understanding the working of NIC cards, Ethernet/Fast Ethernet/Gigabit Ethernet.
2	Crimping of Twisted-Pair Cable with RJ45connector for Straight-Through, Cross-Over, Roll-Over.
3	To understand their respective role in networks/internet.
4	Problem solving with IPv4, which will include the concept of Classful addressing. (supportive Hint: use Cisco Binary Game)
5	Using linux-terminal or Windows-cmd, execute following networking commands and note the output: ping, traceroute, netstat, arp, ipconfig.
6	Create a basic network of two computers using appropriate network wire.
7	Connect multiple (min.6) computers using layer 2 switch.
8	Connect a network in triangular shape with three layer two switches and every switch will have four computers. Verify their connectivity with each other.
9	Create a wireless network of multiple PCs using appropriate access points.
10	Using Wireshark, network analyzer, set the filter for ICMP, TCP, HTTP, UDP, FTP and perform respective protocol transactions to show/prove that the network analyzer is working.

Course Code	SEM – V	Credits	Lectures/Week
25CSMJ513	Paper I – RESEARCH METHODOLOGY	2	2

Course Outcomes:
After successful completion of this course, students would be able to

- CO1: Memorize the fundamentals concepts of research, formulate problems and describe the research process and research methods.
- CO2: Understand ethical issues in research and how to write research papers and publish the same.
- CO3: Articulate basic steps in research methodology including preparing text.
- CO4: Correlate research data using statistical techniques.

Unit	Topics	No of Lectures
I	**Introduction to Research Methodology:** Meaning of Research, Objectives of Research, Motivations in Research, types of Research, Research Approaches, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research. **Defining the Research Problem:** Concept and need, Identification of Research problem, defining and delimiting Research problem. Formulating a Research Problem: Reviewing Literature, formulating a Research Problem, Research Question, Identifying Variables, Constructing Hypothesis **The Research Design:** Meaning, Need for Research Design, Important Concepts, Different Research Designs, Basic Principles of Experimental Designs. **Tools for Data Collection:** Collections of Primary Data, Collection of Data through questionnaire and Schedules, other Observation Interview Methods, Collection of Secondary Data, Selection of appropriate method for data collection, Case Study, Focus Group Discussion, Techniques of developing research tools, viz. Questionnaire and rating scales etc. Reliability and validity of Research tools.	15
II	**Sampling Design:** Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, how to Select a Random Sample. Probability and Non-Probability sampling types and criteria for selection, Developing sampling Frames. **Overview of Hypothesis Testing:** What is a Hypothesis? Characteristics of good Hypothesis. Basic Concepts, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Tests of Hypotheses, and One sided and two-sided hypothesis, Type – I and Type – II errors, Null HypothesisAlternative Hypothesis.	15

	Writing a Research Proposal, what is a Scientific Paper? Ethics in Scientific Publishing. **Preparing the Text:** How to Prepare the Title, how to List the Authors and Addresses, how to Prepare the Abstract, how to Write the Introduction, how to Write the Materials and Methods Section, how to Write the Results, how to Write the Discussion, how to State the Acknowledgments, how to Cite the References. **Publishing the Paper**: Rights and Permissions, How to Submit the Manuscript, How and When to Use Abbreviations, How to Write a thesis, Outcome of Research, Ethical issues in research	

Textbooks:

- Kothari C.R., Research Methodology, New Age International Publication, 5th Edotion 2023
- Research Methodology-A Step-by-Step Guide for Beginners, (4th ed.), Ranjit Kumar, Singapore, Pearson Education,2024
- Research Methodology, Vaishali Khairnar, Staredu Solutions India Pvt Ltd, 2020

Additional References:

- Research Methodology: Methods and Techniques, Dr. R. K. Jain, , Fifth Edition, VEI, 2021
- Research Methodology, R. Panneerselvam, Second Edition, PHI, 2014

Course Code	**ELECTIVE SEM – V**	**Credits**	**Lectures/Week**
25CSEL511	**Paper I – ADVANCE JAVA**	**2**	**2**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Define key concepts related to Java Servlets, JSP, and Hibernate, including the Servlet API, lifecycle, and JDBC architecture.
- CO2: Explain the lifecycle of a Servlet and a JSP page, including the stages involved from creation to destruction.
- CO3: Implements a simple Java Servlet that responds to HTTP requests and generates dynamic content.
- CO4: Analyze the role of the RequestDispatcher interface in servlet communication and how it can be used to forward requests.

Unit	**Topics**	**No of Lectures**
I	**Introduction to Java Servlets:** The Need for Dynamic Content, Java Servlet Technology, Why Servlets? What can Servlets do? **Servlet API and Lifecycle:** Java Servlet API, The Servlet Skeleton, The Servlet Life Cycle, A Simple Welcome Servlet	**15**

	Working with Servlets: Getting Started, Using Annotations Instead of Deployment Descriptor. **Working with Databases:** What Is JDBC? JDBC Architecture, Accessing Database, The Servlet GUI and Database Example. **Request Dispatcher:** Requestdispatcher Interface, Methods of Requestdispatcher,Requestdispatcher Application. **COOKIES:** Kinds of Cookies, Where Cookies Are Used? Creating Cookies, Using Servlet, Dynamically Changing the Colors of A Page **SESSION:** What Are Sessions? Lifecycle of HttpSession, Session Tracking With Servlet API, A Servlet Session Example	
II	**Introduction To Java ServerPages**: Why use Java Server Pages? Disadvantages Of JSP, JSP v\s Servlets, Life Cycle of a JSP Page, How does a JSP function? How does JSP execute? About Java Server Pages **Java Server Pages Standard Tag Libraries:** What is wrong in using JSP Scriptlet Tags? How JSTL Fixes JSP Scriptlet's Shortcomings? Disadvantages Of JSTL, Tag Libraries. **Getting Started With Java Server Pages:** Comments, JSPDocument, JSPElements, JSP GUI Example. **Action Elements:** Including other Files, Forwarding JSP Page to Another Page, Passing Parameters for other Actions, Loading a Java bean. **Introduction to Hibernate:** What is Hibernate? Why Hibernate? Hibernate,Database and The Application, Components of Hibernate, Architecture of Hibernate, How Hibernate Works?	**15**

Textbooks:

- Java EE 7 For Beginners–Sharanam Shah,Vaishali Shah–SPD–First Edition–2017
- Java EE 8 Cookbook–Elder Moraes–Packt–First Edition–2018
- Advanced Java Programming–Uttam Kumar Roy–Oxford Press–First Edition–2015

Additional References:

- Java EE 8 Application Development–David R. Heffelfinger–Packt–First Edition–2017

Course Code	ELECTIVE SEM-V Practical	Credits	Lectures/Week
25CSELP51	**ADVANCE JAVA (P)**	**2**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Identify the key components of a Java Servlet and JSP application, including the role of HTML forms, JDBC, and cookies.
- CO2: Explain the process of user authentication and registration in a web application using Servlets and JDBC.

• CO3: Implements a login servlet that validates user credentials and provides appropriate feedback based on the authentication result. • CO4: Analyzes the flow of data in a registration servlet that accepts user details and stores them in a database using JDBC.	
1	Create a simple calculator application using servlet.
2	Create a servlet for a login page. If the username and password are correct then it says message “Hello ” else a message “login failed”
3	Create a registration servlet in Java using JDBC. Accept the details such as Username, Password, Email, and Country from the user using HTML Form and store the registration details in the database.
4	Using Requestdispatcher Interface create a Servlet which will validate the password entered by the user, if the user has entered "Servlet" as password, then he will be forwarded to Welcome Servlet else the user will stay on the index.html page and an error message will be displayed.
5	Create a servlet that uses Cookies to store the number of times a user has visited servlet.
6	Develop a simple JSP application to pass values from one page to another with validations. (Name-txt, age-txt, hobbies-checkbox, email-txt, gender-radio button).
7	Create a registration and login JSP application to register and authenticate the user based on username and password using JDBC.
8	Create an html page with fields, eno, name, age, desg, salary. Now on submit this data to a JSP page which will update the employee table of database with matching eno.
9	Create a JSP application to demonstrate the use of JSTL
10	Develop a Hibernate application to store and retrieve employee details in MySQL Database.

Course Code	ELECTIVE SEM – V	Credits	Lectures/Week
25CSEL512	Paper - CYBER FORENSIC	2	2

Course Outcomes:
After successful completion of this course, students would be able to

- CO1 : Recall fundamental concepts of cyber forensics and digital evidence.
- CO2 : Summarize the processes and tools used in cyber forensic investigations.
- CO3 : Utilize forensic tools and techniques to analyze and secure digital evidence.
- CO4 : Evaluate forensic data to identify patterns and draw conclusions

Unit	Topics	No of Lectures
I	**Introduction:** Definition and scope of cyber forensics, Types of cybercrimes and digital evidence,Legal and ethical considerations in cyber forensics. **Data Acquisition:** Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions **Processing Crime and Incident Scenes:** Identifying Digital Evidence, Preparing for a Search, Securing a Computer Incident or Crime Scene, Seizing Digital Evidence at the Scene, Storing Digital Evidence **Current Computer Forensics Tools**: Evaluating Computer Forensics Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools	15
II	**Computer Forensics Analysis and Validation:** Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisitions **Network Forensics and Live Acquisitions:** Network Forensics Overview, Performing Live Acquisitions, Developing Standard Procedures for Network Forensics, Using Network Tools. **E-mail Investigations:** Role of E-mail in Investigations, Investigating Email Crimes and Violations, Using Specialized Email Forensics Tools **Cell Phone and Mobile Device Forensics**: Overview, Acquisition Procedures for Cell Phones and Mobile Devices **Report Writing for Investigations:** Importance of Reports, Guidelines for Writing Reports, Generating Report Findings with Forensics Software Tools	15

Textbooks:

- Bill Nelson,Amelia Philips and Christopher Steuart, “Guide to computer forensics and investigations”, course technology,6th edition 2020

Additional References:

- Kevin Mandia, Chris Prosise, “Incident Response and computer forensics”,Tata McGrawHill 2003
- Dr. Akashdeep Bhardwaj ,” Practical Digital Forensics”, BPB publication 2023

	ELECTIVE SEM-V Practical	Credits	Lectures/Week
25CSELP52	**CYBER FORENSIC (P)**	**2**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall and describe the fundamentals of cyber forensics.
- CO2: Explain the processes involved in forensic investigations.
- CO3: Implement forensic tools to analyze and interpret digital evidence.
- CO4: Analyze forensic data to solve complex cases and prepare comprehensive reports.

1	Creating a Forensic Image using FTK Imager/Encase Imager : ● Creating Forensic Image ● Check Integrity of Data ● Analyze Forensic Image
2	Data Acquisition: ● Perform data acquisition using: ● USB Write Blocker + Encase Imager ● SATA Write Blocker + Encase Imager ● Falcon Imaging Device
3	Analyze the memory dump of a running computer system. ● Extract volatile data, such as open processes, network connections, and registry information.
4	Capturing and analyzing network packets using Wireshark (Fundamentals) : ● Identification the live network ● Capture Packets ● Analyze the captured packets
	Using Sysinternals tools for Network Tracking and Process Monitoring : ● Check Sysinternals tools

5	• Monitor Live Processes • Capture RAM • Capture TCP/UDP packets • Monitor Hard Disk • Monitor Virtual Memory • Monitor Cache Memory
6	Recovering and Inspecting deleted files • Check for Deleted Files • Recover the Deleted Files • Analyzing and Inspecting the recovered files • Perform this using recovery option in ENCASE and also Perform manually through command line
7	Steganography Detection • Detect the hidden information or files within digital images using steganography analysis tools. • Extract and examine the hidden content.
8	Mobile Device Forensics • Perform a forensic analysis of a mobile device, such as a smartphone or tablet. • Retrieve call logs, text messages, and other relevant data for investigative purposes.
9	Email Forensics • Analyze email headers and content to trace the origin of suspicious emails. • Identify potential email forgeries or tampering.
10	Web Browser Forensics • Analyze browser artifacts, including history files, bookmarks, and download records. • Analyze cache and cookies data to reconstruct user-browsing history and identify visited websites or online activities. • Extract the relevant log or timestamp file, analyze its contents and interpret the timestamp data to determine the user's last internet activity and associated details.

Course Code	**MINOR SEM – V**	**Credits**	**Lectures/Week**

25CSMR51	Paper I – SOFTWARE TESTING & QUALITY ASSURANCE	2	2

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall and describe the fundamentals concepts of software testing and quality assurance.
- CO2: Summarize the significance of software testing in ensuring software quality, reliability Learn software testing techniques and methodologies for effective test case design.
- CO3:Design and execute test cases to verify the functionality and performance of software systems.
- CO4: Analyze and compare different software testing techniques and understand their strengths and limitations.

Unit	Topics	No of Lectures
I	**Introduction to Software Testing and Quality Assurance** **Introduction to Software Testing:** Nature of errors and the need for testing **Definition of Quality and Quality Assurance:** Understanding quality in software development, Distinction between Quality Assurance (QA), Quality Control (QC), Quality Management (QM), and Software Quality Assurance (SQA) **Software Development Life Cycle (SDLC):** Overview of SDLC phases and their relationship to testing, Role of testing in each phase, Software quality factors and their impact on testing **Verification and Validation (V&V):** Definition of V&V and its significance in software development, Different types of V&V mechanisms, Concepts of Software Reviews, Inspection, and Walkthrough	15
II	**Software Testing Techniques and Strategies** **Testing Fundamentals**: Basics of software testing process, Test case design principles and techniques, Test execution, reporting, and documentation **White Box Testing and Black Box Testing:** Functional/Specification based Testing as Black Box, Black box: Equivalence Partitioning, Boundary Value Analysis, Decision Table Testing, State Transition Testing. Structural Testing as White Box, White Box: Statement testing, Branch testing. Experience-based: Error guessing, Exploratory testing, Checklist-based testing.	15

	Software Testing Strategies: Strategic approach to software testing Unit Testing: purpose, techniques, and best practices, Integration Testing: approaches and challenges, Validation Testing: ensuring adherence to user requirements, System Testing: comprehensive end-to-end testing **Defect Management and Software Quality Assurance** **Defect Management:** Definition of defects and their lifecycle, Defect management process, including defect reporting and tracking, Metrics related to defects and their utilization for process improvement **Software Quality Assurance:** Understanding quality concepts and the Quality Movement: Background issues and challenges in SQA, Activities and approaches in Software Quality Assurance, Software Reviews: Formal Technical Reviews and their benefits, Statistical Quality Assurance and Software Reliability.	

Textbooks:

- Douglas Bell, "Software Engineering for Students, A Programming Approach", 4th Edition,, Pearson Education, 2005
- Roger S. Pressman,"Software Engineering – A Practitioners Approach", 7th Edition, Tata McGraw Hill, 2009

Additional References:

- Quality Management, Donna C. S. Summers, 5th Edition, Prentice-Hall.
- Kshirsagar Naik, Priyadarshi Tripathy ,"Software Testing and Quality Assurance Theory and Practice", John Wiley & Sons, Inc. , Publication.2008

Course Code	MINOR SEM-V Practical	Credits	Lectures/Week
25CSMRP51	**SOFTWARE TESTING & QUALITY ASSURANCE (P)**	**2**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1 Recall fundamental concepts of software testing, including testing principles, defect types, and testing levels.
- CO2 Comprehend the importance of test case design, defect prevention strategies, and testing metrics.
- CO3: Implement various testing techniques such as black-box, white-box, and automated testing in real-world scenarios.
- CO4: Evaluate test results, identify defects, and assess the effectiveness of testing strategies to improve software quality.

1	Install Selenium IDE and create a test suite containing a minimum of 4 test cases for different web page formats (e.g., HTML, XML, JSON, etc.).
2	Conduct a test suite for two different websites using Selenium IDE. Perform various actions like clicking links, filling forms, and verifying content.
3	Install Selenium Server (Selenium RC) and demonstrate its usage by executing a script in Java or PHP to automate browser actions.
4	Write a program using Selenium WebDriver to automate the login process on a specific web page. Verify successful login with appropriate assertions.
5	Write a program using Selenium WebDriver to update 10 student records in an Excel file. Perform data manipulation and verification.
6	Write a program using Selenium WebDriver to select the number of students who have scored more than 60 in any one subject (or all subjects). Perform data extraction and analysis.
7	Write a program using Selenium WebDriver to provide the total number of objects present or available on a web page. Perform object identification and counting.
8	Write a program using Selenium WebDriver to get the number of items in a list or combo box on a web page. Perform element identification and counting.
9	Write a program using Selenium WebDriver to count the number of checkboxes on a web page, including checked and unchecked counts. Perform checkbox identification and counting.
10	Perform load testing on a web application using JMeter. Generate and analyze load scenarios. Additionally, explore bug tracking using Bugzilla as a tool for logging and tracking software defects.

Course Code	VSC SEM-V Practical	Credits	Lectures/Week
25CSVSP51	**GAME PROGRAMMING (P)**	**2**	**4**

Course Outcomes:
After successful completion of this course, students would be able to

- **CO1**: Recall and implement vector mathematics and basic transformations in games
- **CO2**: Explain and implement game loops, events, and sprite-based animations .
- **CO3**: Develop interactive games with physics, collision detection, and sound effects
- **CO4**: Analyze and integrate AI-driven behaviours and optimize games for better performance.

1	Write a program to visualize vector addition, subtraction, and scalar multiplication.
2	Implement basic 2D transformations (translation, scaling, rotation) on shapes using Pygame.
3	Create a Pygame window and display the transformed shapes.
4	Implement a basic game loop with events like quitting or restarting the game.
5	Create a sprite that animates based on player inputs.
6	Simulate gravity and bouncing effects using Pygame.
7	Implement collision detection in a game
8	Create a game with sound effects triggered by specific events
9	Develop a multi-level game with transitions, a game-over screen, and restart functionality.
10	Implement AI behaviour where an enemy chases the player in a 2D environment.

Course Code	FP	Credits	HOURS
25CSFP551	**Field Project**	**2**	**60**

Field Project Implementation Guidelines

- **General Guidelines:**

1. Each department should ensure collaborations/Tie-ups (in terms of MoU/Lol) with relevant academic institutions/industries/organizations/NGO etc. as per project requirements.
2. All the communication with the academic institutions/industries/organizations etc. should be done through the department.
3. Internal faculty should be allotted to the students or group of students for the evaluation of the project.
4. Departments should maintain the relevant documents (such as attendance records, proposals, diary, MoUs/Lol etc) and correspondence regarding Field Project course.

- **Field Project (FP):**

Objectives:

a) To provide practical experience in implementing research projects.
b) To assess students' ability to apply theoretical knowledge in real-world situations.
c) To develop skills in project management, teamwork, and communication.

Note: Field Project 1 Credit = 2 Hours

- **Evaluation Consists of Two Parts:**

Evaluate each student for 50 marks per semester at department level -

- 20 marks for Continuous evaluation (CE)

- Review of project work to be undertaken.
- Progress report on project implementation. (Field diary)

-30 marks for End Semester Examination (ESE)

- Project Report
- Final presentation (PPT) of field project findings assessing project outcomes and reflection.

SEMESTER-VI

Course Code	MAJOR SEM – VI	Credits	Lectures/Week
25CSMJ611	Paper I – DATA SCIENCE	2	2

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Learn the foundations, scope of Data Science, including its applications.
- CO2: Summarize the Data Preprocessing, Data Analysis and machine learning concepts.
- CO3: Develop skills in data preprocessing, including cleaning, transforming, selecting, and merging data, to ensure data quality and suitability for analysis
- CO4: Analyze data and evaluate model performance.

Unit	Topics	No of Lectures
I	**Introduction to Data Science:** What is Data Science?: Definition and scope of Data Science, Applications and domains of Data Science, Comparison with other fields like Business Intelligence (BI), Artificial Intelligence (AI), Machine Learning(ML),and Data Warehousing/DataMining **Data Types and Sources:** Different types of data: structured, unstructured, semi-structured,Extracting Data from different sources:databases, files,APIs,web scraping,sensors,social media **Data Preprocessing:**Data cleaning: handling missing values, outliers, duplicates, Data transformation: scaling, normalization, encoding categorical variables,Feature selection: selecting relevant features/columns,Data merging:combining multiple datasets **Data Wrangling and FeatureEngineering:**Data wrangling techniques: reshaping, pivoting, aggregating, Feature engineering: creating new features,handling time-series data Dummification:converting categorical variables into binary indicators, Feature scaling: standardization, normalization	15
II	**Exploratory Data Analysis (EDA): Data Visualization and Communication:** Principles of effective data visualization, Types of visualizations: bar charts, line charts, scatter plots, etc. Visualization tools: matplotlib, seaborn, Tableau, etc. Data storytelling: communicating insights through visualizations **Descriptive statistics:**Basics of Statistics,Measure of Central Tendency,Measure of Dispersion,Measure of Shape,Measure of Relationship,Probability Theory,Probability Distributions Functions,Parameter estimation for Statistical Inference,Hypothesis Testing,Statistical Tests **Introduction to Machine Learning:**classification : DecisionTrees and Random Forests,Regression: Simple Linear, Multiple Linear, Logistic regression , Stepwise regression, K-means and PCA.	15

Textbooks:

- Principles of Data Science: Understand, analyze, and predict data using Machine Learning concepts and tools , Sinan Ozdemir, Kakade,Tibaldesch, 2018, Second Edition
- Mastering Machine Learning with R by Cory Lesmeister ,PACKT,2015

Additional References:

- Doing Data Science,1st Edition,by Cathy O'Neil (Author), Rachel Schutt,O'Reily,2013
- An Introduction To Statistical Learning With Applications In R, 2Ed (Hb 2021) Hardcover – 13 July 1905,by JAMES G. (Author), Springer

Course Code	MAJOR SEM-V Practical	Credits	Lectures/Week
25CSMJP61	**DATA SCIENCE (P)**	**2**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall fundamental concepts of Data Preprocessing, Data cleaning, Data visualization, and Machine learning
- CO2: Explain data preprocessing, Data cleaning, transforming, selecting, merging, visualization and machine learning techniques.
- CO3: Articulate Data analysis and machine learning techniques.
- CO4: Analyze the findings of a data analysis and machine learning techniques

1	Introduction to Excel ● Perform conditional formatting on a dataset using various criteria. ● Create a pivot table to analyze and summarize data. ● Use VLOOKUP function to retrieve information from a different worksheet or table. ● Perform what-if analysis using Goal Seek to determine input values for desired output.
2	Data Frames and Basic Data Pre-processing ● Read data from different sources. ● Perform basic data pre-processing tasks such as handling missing values and outliers. ● Manipulate and transform data using functions like filtering, sorting, and grouping.
3	Feature Scaling and Dummification ● Apply feature-scaling techniques like standardization and normalization to numerical features. ● Perform feature dummification to convert categorical variables into numerical representations
4	Data Visualization and Storytelling ● Create meaningful visualizations using data visualization tools ● Combine multiple visualizations to tell a compelling data story. ● Present the findings and insights in a clear and concise manner
5	Hypothesis Testing ● Formulate null and alternative hypotheses for a given problem. ● Conduct a hypothesis test using appropriate statistical tests (e.g., t-test, chi square test). ● Interpret the results and draw conclusions based on the test outcomes.
6	ANOVA (Analysis of Variance)

	● Perform one-way ANOVA to compare means across multiple groups. ● Conduct post-hoc tests to identify significant differences between group means.
7	Regression and Its Types ● Implement simple linear regression using a dataset. ● Explore and interpret the regression model coefficients and goodness-of-fit measures. ● Extend the analysis to multiple linear regression and assess the impact of additional predictors
8	Decision Tree ● Implement Decision Tree and Random Forest ● Construct a decision tree model and interpret the decision rules for classification. ● Interpret the results and draw conclusions based on the test outcomes.
9	K-Means Clustering ● Apply the K-Means algorithm to group similar data points into clusters. ● Determine the optimal number of clusters using elbow method or silhouette analysis. ● Visualize the clustering results and analyze the cluster characteristics
10	Principal Component Analysis (PCA) ● Perform PCA on a dataset to reduce dimensionality. ● Evaluate the explained variance and select the appropriate number of principal components. ● Visualize the data in the reduced-dimensional space

Course Code	MAJOR SEM – VI	Credits	Lectures/Week
25CSMJ612	Paper II – CLOUD COMPUTING	2	2

Course Outcomes:

After successful completion of this course, students would be able to

- CO1 Define key concepts related to virtualization, including characteristics of virtualized environments and types of cloud computing.
- CO2 Explain the architecture of CloudSim and its components, including User code, CloudSim, GridSim, and SimJava.
- CO3 Implements basic operations in OpenStack, including tenant model operations and deploying compute resources.
- CO4 Analyze the differences between cloud providers and traditional IT service providers, focusing on service delivery and resource management.

Unit	Topics	No of Lectures
I	**Virtualization**: Characteristics of Virtualized Environments.. Pros and Cons of Virtualization. Virtualization using KVM, Creating virtual machines, oVirt -management tool for virtualization environment. **Introduction to Cloud Computing:** Definition, Types of Clouds, Deployment of software solutions and web applications, Types of Cloud Platforms, Essential characteristics – On- demand self-service, Broad network access, Location independent resource pooling ,Rapid elasticity , Measured service, Comparing cloud providers with traditional IT service providers **Cloud Computing Software Security fundamentals:** Cloud Information Security Objectives, Confidentiality, Integrity, Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Secure Development practices, Approaches to Cloud Software Requirement Engineering, Cloud Security Policy Implementation	15
II	**Cloud Applications** **CloudSim:** Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture(User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, **OpenStack:** Introduction to OpenStack, OpenStack test-drive, Basic OpenStack operations, OpenStack CLI and APIs, Tenant model operations, Quotas, Private cloud building blocks, Controller deployment, Networking deployment, Block Storage deployment, Compute deployment, deploying and utilizing OpenStack in production environments, Building a production environment, Application orchestration using OpenStack Heat **AWS:** Architecting on AWS, Building complex solutions with Amazon Virtual Private Cloud (Amazon VPC)	15

Textbook(s):

1. Java Web Services Up and Running 2nd edition, Martin Kalin, O'Reilly (2013)
2. Pro Power Shell for Amazon Web Services, Brian Beach, Apress, 2014
3. Enterprise Cloud Computing Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
4. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, Tata McGraw Hill Education Private Limited, 2013
5. OpenStack in Action, V. K. CODY BUMGARDNER, Manning Publications Co, 2016

Additional Reference(s):

1. OpenStack Essentials, Dan Radez, PACKT Publishing, 2015 2
2. OpenStack Operations Guide, Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, O'Reilly Media, Inc., 2014
3. https://www.openstack.org

Course Code	MAJOR SEM-V Practical	Credits	Lectures/Week
25CSMJP62	CLOUD COMPUTING (P)	2	4

Course Outcomes:

After successful completion of this course, students would be able to

- CO1 Define and describe key concepts and terminologies related to cloud computing, including IaaS, PaaS, SaaS, virtualization, and cloud security.
- CO2 Explain the working principles of KVM virtualization and cloud services such as AWS RDS, S3, IAM, and Google App Engine.
- CO3 Illustrate MTOM techniques to develop and deploy web applications for downloading/uploading images/videos from/to a server using cloud services.
- CO4 Compare and contrast the features of IaaS and PaaS models in cloud computing and how they impact application deployment.

1	Introduction to Cloud Computing and Deploying a Web Application
2	Installation and Configuration of virtualization using KVM.
3	Develop application to download image/video from server or upload image/video to server using MTOM techniques
4	Setting Up a Cloud Database Service in AWS RDS
5	Creating a Cloud Storage Bucket in AWS S3
6	Implementing Cloud Security with IAM (Identity and Access Management)
7	Install Google App Engine. Create hello world app and other simple web applications using python/java
8	Implement FOSS-Cloud Functionality VSI (Virtual Server Infrastructure) Infrastructure as a Service (IaaS), Storage

9	Implement FOSS-Cloud Functionality - VSI Platform as a Service (PaaS),
10	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

Course Code	**MAJOR SEM – VI**	**Credits**	**Lectures/Week**
25CSMJ613	**Paper – CYBER LAW AND IPR**	**2**	**2**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall the fundamental concepts of cyber laws, internet technology, network security, and key provisions of the Information Technology Act, 2000, including cryptography and digital signatures.
- CO2: Explain the components of cyber law, the legal framework governing e-commerce, e-governance, e-records, and the roles of regulators and certifying authorities in India.
- CO3: Use knowledge of cyber crimes, electronic evidence, and privacy rules to explain real-life situations.
- CO4: Examine digital intellectual property issues such as copyright and patent conflicts, domain name and trademark disputes, and legal challenges related to spamming and phishing.

Unit	**Topics**	**No of Lectures**
I	**Cyber Laws, Internet Technology, and Legal Framework** **Introduction to Cyber Laws and Technology**: Basic Concepts of Cyber Laws, Internet and Advantages and Disadvantages of Internet Technology, Network and Network Security **Legal Framework and Regulations**: Cyber Law and Its Components, Cyber Law in India: Overview of Information Technology Act, 2000. Cryptography, Digital Signature & Electronic Signature. **Key Issues in Cyber Laws:** E-Commerce, E-Governance, E-Record and E-Contract, Regulator and Certifying Authority	**15**
II	**Cyber Crimes, Emerging Issues, and Intellectual Property Right** **Cyber Crimes and Enforcement:** Overview of Cyber Crimes, Powers of Investigation and Search, Introduction to E-Evidence and Computer Forensics **Emerging Issues and Legal Considerations**: ISP & Intermediary Liability, Amendments in Conventional Laws due to Cyber Laws, E-Consumers and Privacy of Online Data **Intellectual Property Rights and Disputes:** Overview of IPR: Copyrights and Patents, Digital copyright and patent issues, Domain Name and Trademark Disputes, Spamming and Phishing: brief legal perspective	**15**

Textbooks:

- Cyber Laws & Information Technology (For LL.B.) Paperback – 1 January 2020
- Cyber Law in India, Satish Chandra, ABS Books, 2017
- Cyber Security and Cyber Laws, Nilakshi Jain, Wiley India, October 2020

Additional References:

- Cyber Laws, Justice Yatindra Singh, Universal Law Publishing, Universal Publishing, 2016
- Cyber laws, Dr. Gupta & Agrawal, PREMIER PUBLISHING COMPANY, 2022
- Cyber Law - An Exhaustive Section Wise Commentary On The Information Technology, Pavan Duggal, Universal Publishing (LexisNexis), 2nd Edition, 2017

Course Code	ELECTIVE SEM – VI	Credits	Lectures/Week
25CSEL611	Paper I – ETHICAL HACKING	2	2

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall the fundamental concepts of ethical hacking, hacking techniques, Phases including its legal and ethical implications.
- CO2: Gain the knowledge of various hacking techniques and their role in identifying vulnerabilities.
- CO3: Implement ethical hacking tools and techniques to assess system security.
- CO4: Evaluate security vulnerabilities and recommend solutions to mitigate risks.

Unit	Topics	No of Lectures
I	**Introduction:** Terminology, Hacking Technology Types, Ethical Hacking Phases, Hacktivism, Hacker Classes, Skills Required for an Ethical Hacker, Vulnerability Research, Ways to Conduct Ethical Hacking **Footprinting:** Definition, Information Gathering Methodology, Competitive Intelligence, DNS Enumeration, Whois and ARIN Lookups, Types of DNS Records, Traceroute in Footprinting, E-Mail Tracking **Social Engineering:** Common Types Of Attacks **Scanning and Enumeration:** Port Scanning, Network Scanning, Vulnerability Scanning, CEH Scanning Methodology, Ping Sweep Techniques, Nmap Command Switches, SYN, Stealth, XMAS, NULL, IDLE, FIN Scans, Anonymizers, HTTP Tunneling Techniques, IP Spoofing Techniques, SNMP Enumeration, Steps Involved in Enumeration	15
II	**System Hacking:** Password-Cracking Techniques, Types of Passwords, Keyloggers and Other Spyware Technologies, Escalating Privileges, Rootkits **Sniffers:**Active and Passive Sniffing, ARP Poisoning, MAC Flooding, DNS Spoofing Techniques, Sniffing Countermeasures **Denial of Service:** Types of DoS Attacks, Working of DoS Attacks, BOTs/BOTNETs, “Smurf” Attack, “SYN” Flooding, DoS/DDoS	15

	Countermeasures **Session Hijacking:** Spoofing vs. Hijacking, Types, Sequence Prediction, Steps, Prevention. **Hacking Web Servers:** Web Server Vulnerabilities, Attacks against Web Servers, Patch Management Techniques, Web Server Hardening **Web Application Vulnerabilities:** Web Application Hacking, Web Application Threats, Google Hacking, Countermeasures **Web-Based Password Cracking Techniques:** Authentication Types, Password Crackers, Countermeasures **SQL Injection:** Steps, SQL Server Vulnerabilities, Countermeasures **Buffer Overflows:** Types, Stack-Based Buffer Overflows, Mutation Techniques **Wireless Hacking:** WEP, WPA Authentication Mechanisms, and Cracking Techniques, Wireless Sniffers, Rogue Access Points, Wireless Hacking Techniques, Securing Wireless Networks. **Penetration Testing Methodologies:** Methodologies, Steps, Automated Tools, Pen-Test Deliverables	

Textbooks:

- CEH official Certified Ethical Hacking Review Guide, Wiley India Edition 2007
- Ric Messier, R Messier, "CEH v11 Certified Ethical Hacker Study Guide (Paperback)", Wiley , 4 Jul 2021

Additional References:

- Omkar Santos and Michael Gregg, "Certified Ethical Hacker CEH Version 10 cert Guide", THird edition Pearson Education
- Matt Walker, "Certified Ethical Hacker All in one exam Guide" TMH, fourth edition 2019

Course Code	ELECTIVE SEM-V Practical	Credits	Lectures/Week
25CSELP61	**ETHICAL HACKING (P)**	**2**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall the the concept of ethical hacking and its methodology
- CO2: Summarize the use of various tools for ethical hacking.
- CO3: Discover ethical hacking methodologies to conduct comprehensive security assessments and penetration tests and Perform effective footprinting and reconnaissance techniques to gather critical information about target systems.
- CO4: Identify and exploit vulnerabilities in various network and system components using appropriate tools and techniques.

1	Google and Whois Reconnaissance ● Use Google search techniques to gather information about a specific target or organization.

	● Utilize advanced search operators to refine search results and access hidden information. Perform Whois lookups to retrieve domain registration information and gather details about the target's infrastructure
2	Password Encryption and Cracking with CrypTool and Cain and Abel ● Password Encryption and Decryption: o Use CrypTool to encrypt passwords using the RC4 algorithm. o Decrypt the encrypted passwords and verify the original values.
3	Linux Network Analysis and ARP Poisoning ● Linux Network Analysis: o Execute the ifconfig command to retrieve network interface information. o Use the ping command to test network connectivity and analyze the output. o Analyze the netstat command output to view active network connections. o Perform a traceroute to trace the route packets take to reach a target host. ● ARP Poisoning: o Use ARP poisoning techniques to redirect network traffic on a Windows system. Analyze the effects of ARP poisoning on network communication and security.
4	Port Scanning with NMap ● Use NMap to perform an ACK scan to determine if a port is filtered, unfiltered, or open. ● Perform SYN, FIN, NULL, and XMAS scans to identify open ports and their characteristics. Analyze the scan results to gather information about the target system's network services.
5	Network Traffic Capture and DoS Attack with Wireshark and Nemesy ● Network Traffic Capture: o Use Wireshark to capture network traffic on a specific network interface. Analyze the captured packets to extract relevant information and identify potential security issues. ● Denial of Service (DoS) Attack: o Use Nemesy to launch a DoS attack against a target system or network. Observe the impact of the attack on the target's availability and performance.
6	Persistent Cross-Site Scripting Attack ● Set up a vulnerable web application that is susceptible to persistent XSS attacks. ● Craft a malicious script to exploit the XSS vulnerability and execute arbitrary code. Observe the consequences of the attack and understand the potential risks associated with XSS vulnerabilities.
7	Session Impersonation with Firefox and Tamper Data ● Install and configure the Tamper Data add-on in Firefox. ● Intercept and modify HTTP requests to impersonate a user's session. Understand the impact of session impersonation and the importance of session management.

8	SQL Injection Attack ● Identify a web application vulnerable to SQL injection. ● Craft and execute SQL injection queries to exploit the vulnerability. Extract sensitive information or manipulate the database through the SQL injection attack.
9	Creating a Keylogger with Python ● Write a Python script that captures and logs keystrokes from a target system. ● Execute the keylogger script and observe the logged keystrokes. Understand the potential security risks associated with keyloggers and the importance of protecting against them.
10	Exploiting with Metasploit (Kali Linux) ● Identify a vulnerable system and exploit it using Metasploit modules. ● Gain unauthorized access to the target system and execute commands or extract information. Understand the ethical considerations and legal implications of using Metasploit for penetration testing.

Course Code	ELECTIVE SEM – VI	Credits	Lectures/Week
25CSEL612	INFORMATION AND NETWORK SECURITY	2	2

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall various concepts of network security
- CO2: Describe various cryptographic techniques.
- CO3: Assess and Apply various cryptographic techniques
- CO4: Analyze Particular information and network security Problems

Unit	Topics	No of Lectures
I	**Introduction**: Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms. **Classical Encryption Techniques**: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, AES (round details not expected), Multiple Encryption and Triple DES, Block Cipher Modes of Operation, Stream Ciphers. **Public-Key Cryptography and RSA**: Principles of Public-Key Cryptosystems, The RSA Algorithm. **Key Management**: Public-Key Cryptosystems, Key Management, Diffie-Hellman Key Exchange. **Message Authentication and Hash Functions**: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and Macs, Secure Hash Algorithm, HMAC.	15
II	**Digital Signatures and Authentication**: Digital Signatures, Authentication Protocols, Digital Signature Standard **Authentication Applications**: Kerberos, X.509 Authentication, Public-Key Infrastructure. **Electronic Mail Security**: Pretty Good Privacy, S/MIME **IP Security**: Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management **Web Security**: Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction **Intrusion**: Intruders, Intrusion Techniques, Intrusion Detection Malicious Software: Viruses and Related Threats, Virus Countermeasures, DDOS **Firewalls**: Firewall Design Principles, Types of Firewalls	15

Textbooks:

- Cryptography and Network Security: Principles and Practice 7th edition, William Stallings, Pearson

Additional References:

- Cryptography and Network, 2nd edition, Behrouz A Fourouzan, Debdeep Mukhopadhyay, TMH.
- Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill.

Course Code	ELECTIVE SEM-VI Practical	Credits	Lectures/Week
25CSELP62	**INFORMATION AND NETWORK SECURITY (P)**	**2**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall various concepts of network security
- CO2: Describe various cryptographic techniques.
- CO3: Assess and Apply various cryptographic techniques
- CO4: Analyze Particular information and network security Problems

1	**Implementing Substitution and Transposition Ciphers:** Design and implement algorithms to encrypt and decrypt messages using classical substitution and transposition techniques.
2	**RSA Encryption and Decryption:** Implement the RSA algorithm for public-key encryption and decryption, and explore its properties and security considerations.
3	**Message Authentication Codes:** Implement algorithms to generate and verify message authentication codes (MACs) for ensuring data integrity and authenticity.
4	**Digital Signatures:** Implement digital signature algorithms such as RSA-based signatures, and verify the integrity and authenticity of digitally signed messages.
5	**Key Exchange using Diffie-Hellman:** Implement the Diffie-Hellman key exchange algorithm to securely exchange keys between two entities over an insecure network.
6	**IP Security (IPsec) Configuration:** Configure IPsec on network devices to provide secure communication and protect against unauthorized access and attacks.
7	**Web Security with SSL/TLS:** Configure and implement secure web communication using SSL/TLS protocols, including certificate management and secure session establishment.
8	**Intrusion Detection System:** Set up and configure an intrusion detection system (IDS) to monitor network traffic and detect potential security breaches or malicious activities.
9	**Malware Analysis and Detection:**

	Analyze and identify malware samples using antivirus tools, analyze their behavior, and develop countermeasures to mitigate their impact.
10	**Firewall Configuration and Rule-based Filtering:** Configure and test firewall rules to control network traffic, filter packets based on specified criteria, and protect network resources from unauthorized access.

Course Code	MINOR SEM – VI	Credits	Lectures/Week
25CSMR611	Paper I – DATA WAREHOUSING	2	2

Course Outcomes:

- CO1: Recall fundamental concepts of data mining, including its purpose, techniques, and applications.
- CO2: Explain the methodologies and algorithms used in data mining, such as classification, clustering, and association rule mining.
- CO3: Implement data mining techniques to solve real-world problems using tools like Python, R, or Weka.
- CO4: Evaluate the effectiveness of different data mining approaches and compare their performance on various datasets

Unit	Topics	No of Lectures
I	**Introduction to Data Warehousing**: Overview of Data Warehousing, Differences between OLTP and OLAP Systems, Data Warehousing Architecture and Workflow. **Dimensional Modeling:** Introduction to Dimensional Data Modeling,Star Schema and Snowflake Schema, Fact Tables and Dimension Tables. **ETL (Extract, Transform, Load) Processes**: Data Extraction and Cleaning,Transformation Techniques, Data Loading Strategies.	**15**
II	**OLAP (Online Analytical Processing):** Concepts of OLAP and Data Cubes, OLAP Operations: Slicing, Dicing, Drill Down, and Roll Up. **Data Warehouse Performance Optimization:** Query Optimization, Indexing Techniques. **Data Visualization and Reporting:** Introduction to Business Intelligence Tools,Creating Dashboards and Reports.	**15**

Textbooks:

- Data Warehousing : Design, Development And Best Practices by Soumendra Mohanty (Author), Tata McGraw Hill Education (Publisher).
- Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
- Ralph Kimball, “The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling”, Third edition, 2013

Additional References:

- Pualraj Ponnaiah, Wiley, “Data Warehousing Fundamentals”, Student Edition, 2004.
- Ralph Kimball, Wiley, “The Data warehouse Life Cycle Toolkit”, Student Edition, 2006.

Course Code	MINOR SEM-V Practical	Credits	Lectures/Week
25CSMRP61	DATA WAREHOUSING (P)	2	4

Course Outcomes:

After successful completion of this course, students would be able to

- CO1: Recall fundamental concepts of data mining, including its purpose, techniques, and applications.
- CO2: Describe the methodologies and algorithms used in data mining, such as classification, clustering, and association rule mining.
- CO3: Implement data mining techniques to solve real-world problems using tools like Python, R, or Weka.
- CO4: Evaluate the effectiveness of different data mining approaches and compare their performance on various datasets

1	Exploring Data Warehouse Architecture - Study the architecture of a simple data warehouse and explain its components.
2	Designing a Star Schema - Create a star schema for a retail business scenario, defining fact and dimension tables.
3	Implementing Snowflake Schema - Develop a snowflake schema for a healthcare domain and understand its advantages over star schema.
4	ETL Process Implementation - Use an ETL tool (e.g., Talend, Informatica) to extract, clean, and load data into a data warehouse.
5	Data Loading Strategies - Demonstrate full and incremental data loading techniques on a sample warehouse.
6	Performing OLAP Operations - Use tools like Microsoft SSAS or Pentaho to perform slicing, dicing, drill-down, and roll-up on a data cube.
7	Query Optimization - Analyze and optimize SQL queries for improved data retrieval performance.
8	Integrating Data Warehouse with BI Tools - Connect a data warehouse to a Business Intelligence tool (e.g., Tableau, Power BI) and create visual dashboards.
9	Real-Time Data Warehousing - Explore and implement basic real-time data warehousing concepts on streaming data.
10	Final Mini-Project - End-to-end implementation of a data warehouse for a chosen domain (e.g., retail, banking), including schema design, ETL, and reporting.

OJT

Evaluation Scheme for Third Year (UG) under NEP (2 credits)

I. Internal Evaluation for Theory Courses – 20 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 10 marks

II. External Examination for Theory Courses – 30 Marks

Duration: 1 Hours

Theory question paper pattern: All questions are compulsory.

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15

- Each Question may be subdivided into sub questions as a, b, c, d, or p, q, r, s and should attempt either a, b, c, d or p, q,r, s & the allocation of Marks depends on the weightage of the topic and course objective

- **Paper Pattern of Theory Paper:**

DES's Kirti M. Doongursee College (AUTONOMOUS), Dadar (W), Mumbai-28			
Regular / Additional / ATKT Examination			
Duration: 1 Hour			**Max Marks: 30**
Date: **Time:** **Code:** ***(For office use)***			
N. B.	i)	*All Questions are compulsory.*	
	ii)	*Mixing of sub-questions is not allowed*	
	iii)	*Draw neat labeled diagrams wherever necessary.*	
Q. No.			**Marks**
Q.1 A)			**05**
Q.1 B)			**05**
Q.1 C)			**03**
Q.1 D)			**02**
OR			
Q.1 P)			**05**

Q.1 Q)		**05**
Q.1 R)		**03**
Q.1 S)		**02**
Q.2 A)		**05**
Q.2 B)		**05**
Q.2 C)		**03**
Q.2 D)		**02**
OR		
Q.2 P)		**05**
Q.2 Q)		**05**
Q.2 R)		**03**
Q.2 S)		**02**

III. Practical Examination

- Each core subject carries 50 Marks (20M Internal + 30M External)
- A minimum of 80% practical from each core subject is required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam.

NOTE:

1. **To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.**
2. **There is separate passing in internal and external theory courses.**