BCA (System Administration and Cyber Security)
Detailed Syllabus

Semester – V
3SCS5-SI-005-P
Summer Internship
Pre-requisites: Basics of Computer Knowledge

Course Category			
L	**T**	**P**	**C**
0	0	4	2

Course Objective:

- To define project requirements and select the appropriate technical domain for development.
- To maintain a daily work log that explains the logic and progress of the system.
- To implement a functional project through a disciplined 60-minute daily coding routine.
- To analyze and debug the system to ensure it meets performance and syllabus-aligned standards.
- To evaluate project outcomes and create a professional Detailed Project Report (DPR) for certification.

Course Outcomes:

Course Outcomes (COs)	Level *
CO1: Select project topics and define the necessary technical requirements.	L2
CO2: Maintain daily work logs and explain project logic through flowcharts.	L2
CO3: Build a functional project through a disciplined 60-minute daily coding routine.	L3
CO4: Test the application and debug code to ensure smooth performance.	L4
CO5: Summarize project results and prepare a professional report for certification.	L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..*

Course Contents:

- The internship aims to transform theoretical academic knowledge into a functional practical project and develop professional skills.
- Students must dedicate exactly 60 minutes of uninterrupted daily work to their project to ensure consistent progress.
- This daily hour must be divided between active development (coding/design) and documenting the progress made during the session.
- Students may choose any problem statement or project domain that aligns with the core concepts of their academic curriculum.
- Every task must follow a structured approach: from requirement analysis and design to implementation and final testing.
- Maintaining a digital 'Daily Log' is mandatory, detailing the specific tasks completed each day and the goals for the next session.
- Students must regularly update their work on a version control platform to maintain a history of their project's evolution.
- A Detailed Project Report must be submitted at the end, including system architecture, flowcharts, and final results.
- Final grading will be based on the student's consistency, the quality of the technical implementation, and the clarity of the report.
- An official Internship Completion Certificate will be awarded only after the successful submission of the report and a final project demonstration.

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Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, Assignment I-V, Q, MST-I & II #)**
Weightage (%)	50	50

*A-Attendance; Assignment I-V (Class Assignment/Home Assignments/Case Discussions/Term Papers/Mini Project); Q-Quiz (5 Quizzes), MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

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BCA (System Administration and Cyber Security)
Detailed Syllabus

Semester – V | **Course Category**
3SCS5-SE-004-T | **L T P C**
Introduction to Artificial Intelligence | 3 0 0 3
Pre-requisites: Basics of Computer Knowledge

Course Objective:

- To describe AI foundations and search strategies for basic problem-solving.
- To apply heuristic algorithms and logic to represent complex knowledge.
- To implement search algorithms and data models using Python programming.
- To analyze NLP techniques and game-playing strategies for intelligent interaction.
- To design expert systems and probabilistic models to handle real-world uncertainty.

Course Outcomes:

Course Outcomes (COs)	Level *
CO1: Identify AI problems and select appropriate search strategies like BFS or DFS for efficient problem solving.	L2
CO2: Apply heuristic techniques like A* and AO* along with logic-based knowledge representation to solve structured problems.	L2 & L3
CO3: Implement core AI algorithms, Hidden Markov Models, and data structures using Python programming.	L3
CO4: Analyze NLP parsing techniques and game-playing strategies like Minimax and Alpha-Beta pruning.	L3 & L4
CO5: Design expert systems and probabilistic models using Bayesian networks to handle real-world uncertainty.	L4 & L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..*

Articulation Matrix:-

(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO 1	PSO 2
CO1	1	–	1	1	–	–	-	–	–	2	1	-
CO2	-	–	2		–	–	1	–	–	1	1	2
CO3	2	1	2		–	–	-	–	–	2	-	3
CO4	3	–	2	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	3	1	–	2	3	1

High-3 Medium-2 Low-1

Course Contents:

Unit 1: Introduction & Intelligent Agents

Rationality paradigms, Foundations of cognitive simulation, Turing Test constraints, Strong vs. Weak AI dichotomies, Teleological vs. Deontological AI models, Agent-Environment interaction loops, PEAS specification matrices, Environmental taxonomies (Episodic, Stochastic, Dynamic, Continuous, Multi-agent), Rational agent architectures, Condition-action rule-bases, Model-based state tracking, Teleological goal utility optimization.

Unit 2: Problem Solving and Search Algorithms

State-space formalization, Combinatorial optimization, Heuristic graph abstractions, Uninformed search mechanics, Time-space complexity constraints ($O(b^d)$ vs $O(b^m)$), Completeness and optimality proofs, Breadth-First and Depth-First tree traversals, Uniform Cost search mechanics, Heuristic evaluation functions ($h(n)$), Overestimation bounds, Admissibility and monotonicity constraints, A^* search graph optimization, Zero-sum adversarial game trees, Minimax minimax-value maximization, Alpha-Beta pruning state-space reduction techniques.

Unit 3: Knowledge Representation and Reasoning

Knowledge-based systems architecture, Propositional calculus syntax and semantics, Monotonic reasoning, Truth-functional validity and satisfiability (NP-completeness), Resolution refutation proofs, Horn clause restrictions, Forward and backward chaining inference engines, First-Order Predicate Logic (FOL), Universal and existential quantification mechanics, Syntactic unification algorithms, Structured taxonomies and ontologies, Non-monotonic reasoning under epistemic uncertainty, Axiomatic probability theory, Joint probability distributions, Bayesian inference networks, Directed Acyclic Graph (DAG) d-separation, Exact inference by marginalization.

Unit 4: Machine Learning Foundations

Inductive learning paradigms, Supervised vs. Unsupervised vs. Reinforcement Learning taxonomies, Markov Decision Processes (MDPs), Objective functions, Empirical risk

minimization, Ordinary Least Squares (OLS) linear regression, Stochastic Gradient Descent (SGD) convergence, Information theory fundamentals, Shannon Entropy, Information Gain optimization in Decision Trees, Parametric classification via Naive Bayes, Conditional feature independence assumptions, Non-parametric partitioning via K-Means clustering, Euclidean distance optimization, Convergence metrics, Mathematical Perceptron models, Synaptic weights, bias thresholds, Non-linear activation functions (Sigmoid, Tanh, ReLU), Multi-layer perceptron topologies, Feedforward error propagation, Backpropagation via partial derivative chain rules.

Unit 5: AI Applications, Ethics, and Future Trends

Computational linguistics pipelines, Syntactic and semantic textual parsing, Tokenization, Lemmatization, Vector space embeddings, Self-attention mechanisms, Transformer network topologies, Generative Autoregressive Language Models, Computer Vision matrices, Spatial pixel coordinate mapping, Spatial feature extraction, Object detection bounding-box regression, Semantic segmentation, Convolutional Neural Network (CNN) kernels, Robotics kinematic interfaces, Actuation loops, Simultaneous Localization and Mapping (SLAM) algorithms, Algorithmic bias and systemic data skew, Differential privacy vectors, Generative adversarial deepfakes, Epistemic hallucinations, Automation-driven socio-economic disruption models.

Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, Assignment I-V, Q, MST-I & II #)**
Weightage (%)	60	40

*A-Attendance; Assignment I-V (Class Assignment/Home Assignments/Case Discussions/Term Papers/Mini Project); Q-Quiz (5 Quizzes), MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

List of Books:

Textbook:

1. **Artificial Intelligence: A Modern Approach**, Stuart Russell and Peter Norvig, Pearson Education, 4th Edition, 2020.

Reference Books:

1. **Artificial Intelligence**, Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Tata McGraw Hill, 3rd Edition, 2009.

2. **Introduction to Artificial Intelligence and Expert Systems**, Dan W. Patterson, Pearson Education, 1st Edition, 2015.
3. **Learning Python**, Mark Lutz, O'Reilly Media, 5th Edition, 2013. (Unit-III के लिए)
4. **Principles of Artificial Intelligence**, Nils J. Nilsson, Narosa Publishing House, 1st Edition, 2002.
5. **Artificial Intelligence and Soft Computing: Behavioral and Cognitive Modeling of the Human Brain**, Amit Konar, CRC Press, 1st Edition, 2018.

Important Websites:

1. **NPTEL (IIT Madras): Artificial Intelligence Search Methods for Problem Solving, Prof. Deepak Khemani – https://nptel.ac.in/courses/106106126 (Video Lecture)**
2. **UC Berkeley: CS188 Introduction to Artificial Intelligence (Pacman Projects) – https://inst.eecs.berkeley.edu/~cs188/ (Practical Resource)**
3. **MIT OpenCourseWare: 6.034 Artificial Intelligence by Prof. Patrick Winston – https://ocw.mit.edu/courses/6-034-artificial-intelligence/ (Video Lecture)**
4. **Stanford Online: CS221 Artificial Intelligence: Principles and Techniques – https://stanford-cs221.github.io/ (Course Materials)**
5. **Python Official Documentation: Python 3 Language Reference and Tutorials – https://docs.python.org/3/ (Technical Guide)**
6. **GeeksforGeeks: Artificial Intelligence Tutorials and Implementation – https://www.geeksforgeeks.org/artificial-intelligence-an-introduction/ (Quick Reference)**

BCA (System Administration and Cyber Security)

Semester – V
3SCS5-DM-003-T
Cloud Security
Pre-requisites: Basic Knowledge of Database

Course Category			
L	**T**	**P**	**C**
4	0	0	4

Course Objective:

- To understand network security policies and how cloud delivery models (SPI) change traditional security.
- To apply vulnerability scanning and penetration testing to identify threats in cloud environments.
- To analyze risk tolerance and legal/regulatory issues specific to cloud computing.
- To evaluate cloud security using professional checklists and performance metrics.
- To create secure virtual environments by hardening hypervisors and managing incident response teams (CSIRT).

Course Outcomes:

Course Outcomes (COs)	**Level ***
CO1: Explain SPI framework evolution and implement network security policies for cloud models.	L2
CO2: Use security design principles to maintain Confidentiality, Integrity, and Availability (CIA) in the cloud.	L2
CO3: Assess risk tolerance and navigate legal/regulatory challenges in cloud deployments.	L3
CO4: Critique cloud security posture using standardized metrics and evaluation checklists.	L4
CO5: Design defence strategies against hypervisor risks and manage virtual machine (VM) hardening.	L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..*

Articulation Matrix:-
(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO 1	PSO 2
CO1	1	–	1	1	–	–	-	–	–	1	1	-
CO2	-	–	2		–	–	1	–	–	-	1	2
CO3	2	1	-		–	–	-	–	–	2	-	3
CO4	3	–	2	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	3	1	–	2	3	1

High-3 Medium-2 Low-1

Course Contents:

Unit-I: Network Security & SPI Evolution

Next-Gen Network Security, Software-Defined Perimeter (SDP), Implementation of Zero Trust policies, Advanced Reconnaissance, Modern Vulnerability scanning, Cloud-native Penetration testing, Post-Attack Investigation, AI-driven log analysis, Digital Forensics, Root Cause Analysis (RCA), SPI Evolution 2026, Serverless (FaaS), Edge Computing delivery models, The Shared Responsibility Model, Provider vs. customer duties across hybrid clouds.

Unit-II: Cloud Security Architecture & CIA

Security Objectives, Confidentiality, Integrity, Availability, Privacy and Non-repudiation in multi-cloud setups, Advanced Threats, Ransomware-as-a-Service (RaaS), API vulnerabilities, Identity-based attacks, Cloud Security Design, Security-as-Code (SaC), DevSecOps integration, Requirements Engineering, Decomposing security policies into automated cloud-native configurations.

Unit-III: Risk Management & Modern Compliance

Assessing Risk Tolerance, Quantitative risk assessment, AI tools for predictive threat modeling, Legal & Global Privacy, GDPR, India's DPDP Act, International data sovereignty laws, Cloud Auditing, Continuous compliance management, Real-time auditing, SLA & Liability, Legal aspects of data breaches, Service provider accountability.

Unit-IV: Evaluation Frameworks & Security Metrics

Evaluation Checklists, CSA (Cloud Security Alliance) STAR, CCM (Cloud Controls Matrix), Security Metrics, Mean Time to Detect (MTTD), Mean Time to Respond (MTTR), Continuous Monitoring, Dashboards for real-time visibility, Automated security posture management (CSPM).

Unit-V: Virtualization, Container & Incident Defense
Hypervisor & VM Security, Defense against VM Escape, Side-channel attacks, Hypervisor hardening, Container Security, Securing Docker and Kubernetes, Image scanning, Pod security policies, Incident Response (CSIRT), Playbook-driven response, Automated containment, Disaster recovery, Hardening & Remote Access, Zero Trust Network Access (ZTNA) vs. traditional VPNs.

Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, Assignment I-V, Q, MST-I & II #)**
Weightage (%)	60	40

*A-Attendance; Assignment I-V (Class Assignment/Home Assignments/Case Discussions/Term Papers/Mini Project); Q-Quiz (5 Quizzes), MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

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Reference Books:

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2. **Practical Cloud Security**: A Guide for Secure Cloud Design, Chris Dotson, O'Reilly Media, 1st Edition, 2019.
3. **Virtualization Security**: Protecting Virtualized Environments, Dave Shackleford, John Wiley & Sons, 1st Edition, 2013.

Important Websites:

1. **Cloud Security Tutorial, TutorialsPoint**, https://www.tutorialspoint.com/cloud_computing/cloud_computing_security.htm, 2026.
2. **Introduction to Cyber Security, GeeksforGeeks,** https://www.geeksforgeeks.org/cloud-computing-security-challenges/, 2026.
3. **Cloud Computing and Distributed Systems, Prof. Rajiv Misra, NPTEL (IIT Patna),** https://nptel.ac.in/courses/106104182, 2026.
4. **AWS Cloud Security Concepts, AWS Training Video,** https://explore.skillbuilder.aws/learn/course/external/view/elearning/1927/aws-security-fundamentals, 2026.

BCA (System Administration and Cyber Security)

Semester – V	**Course Category**			
3SCS5-DE-002-T-03	**L**	**T**	**P**	**C**
Data Mining & Warehousing	4	0	0	4
Pre-requisites: None				

Course Objective:

- To explain the basic concepts, principles, and techniques of data mining.
- To apply data mining techniques to perform systematic analysis of real-world problems.
- To analyze data mining problems and interpret results using appropriate methods.
- To evaluate, visualize, and communicate statistical models effectively.
- To use data mining tools for data analysis and support data warehouse management..

Course Outcomes:

Course Outcomes (COs)	**Level ***
CO1: Explain the basic concepts, principles, and techniques of data mining.	L2
CO2: Apply data mining techniques to perform systematic analysis of real-world problems.	L2 & L3
CO3: Analyze data mining problems and interpret results using appropriate methods.	L4
CO4: Evaluate, visualize, and communicate statistical models effectively.	L4 & L5
CO5: Use data mining tools for data analysis and support data warehouse management.	L4 & L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..*

Articulation Matrix:-
(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	–	1	1	–	–	-	–	–	1	1	-
CO2	-	–	2		–	–	1	–	–	1	1	2
CO3	2	1	1		–	–	-	–	–	2	-	3
CO4	3	–	2	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	3	1	–	2	3	1

High-3 Medium-2 Low-1

Course Contents:

UNIT – I: Data Warehouse
Introduction to Data warehouse, Differences between operational database systems and data warehouse, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction-Transformation-Loading, Logical (Multi-Dimensional), Data Modeling, Schema Design, star and snow-flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures; Fact- Less-Facts, Dimension Table characteristics; Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP.

UNIT -II: Introduction to Data Mining
Introduction to Data Mining: Introduction, what is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing- Data Cleaning, Missing Data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of similarity and dissimilarity-Basics.

UNIT – III: Association Rules
Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set-Maximal Frequent Item Set, Closed Frequent Item Set.

UNIT -IV: Classification
Problem definition, General Approaches to solving a classification problem, Evaluation of Classifiers, Classification techniques, Decision Trees-Decision Tree Construction, Methods for expressing attribute test conditions, Measures for Selecting the Best split, Algorithm for Decision tree Induction, Naïve-Bayes Classifier, Bayesian Belief Networks; K-nearest neighbor classification-Algorithm and characteristics.

UNIT – V: Clustering
Problem Definition, Clustering overview, Evaluation of clustering algorithms, Partitioning clustering K-Means Algorithm, K-Means Additional Issues, PAM Algorithm, Hierarchical Clustering-Algorithm- Agglomerative Methods and Divisive Methods, Basic Agglomerative

Hierarchical Clustering Algorithm, Specific techniques, Key Issues in Hierarchical Clustering, Strengths and weakness, Outlier Detection.

Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, Assignment I-V, Q, MST-I & II #)**
Weightage (%)	60	40

*A-Attendance; Assignment I-V (Class Assignment/Home Assignments/Case Discussions/Term Papers/Mini Project); Q-Quiz (5 Quizzes), MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

List of Books:

Textbook:

1. **Data Mining-Concepts and Techniques-** Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006.
2. **Introduction to Data Mining,** Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.

Reference Books:

1. **Data Mining Techniques**, Arun K Pujari, 3rd Edition, Universities Press.
2. **Data Ware Housing Fundamentals**, Pualraj Ponnaiah, Wiley Student Edition.

Important Websites:

1. **NPTEL (https://www.nptel.com)**
2. **Coursera (https://www.coursera.com)**
3. **Javatpoint (https://www.javatpoint.com)**
4. **Simplilearn (https://www.simplilearn.com)**

BCA (System Administration and Cyber Security)

Semester – V
3SCS5-DE-002-T-02
Server less Computing
Pre-requisites: None

Course Category			
L	**T**	**P**	**C**
4	0	0	4

Course Objective:

- To explain the shift from traditional infrastructure management to event-driven FaaS (Function-as-a-Service) models.
- To design Secure serverless applications by applying the Shared Responsibility Model to divide duties between provider and user.
- To implement zero Trust policies and AI-driven monitoring tools to protect cloud-native environments.
- To analyze the SPI Evolution 2026 and its specific impact on the delivery of Edge and Hybrid cloud services.
- To evaluate the efficiency of automatic scaling and pay-per-use billing compared to traditional cloud hosting.

Course Outcomes:

Course Outcomes (COs)	Level *
CO1: Explain the core concepts of **FaaS, BaaS**, and SPI evolution to manage automatic scaling and network security policies.	L2
CO2: Design secure cloud architectures using **IAM** and **Least Privilege** principles to maintain the CIA triad and restrict unauthorized access.	L2
CO3: Apply modern vulnerability scanning and **digital forensics** techniques to investigate attacks and navigate security challenges in serverless apps.	L3
CO4: Analyze the division of provider vs. customer duties within **Hybrid and Multi-cloud** environments to manage shared responsibility risks.	L4
CO5: Troubleshoot security and performance issues within modern **Edge Computing** delivery models and manage serverless execution risks.	L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome.*

Articulation Matrix:-
(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	1	–	1	1	–	–	-	–	–	1	1	-
CO2	-	–	2		–	–	1	–	–	2	1	2
CO3	2	1	3		–	–	-	–	–	2	-	3
CO4	1	–	2	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	1	1	–	2	3	1

High-3 Medium-2 Low-1

Course Contents:

Unit-I: Introduction to Serverless & FaaS Fundamentals

Concepts of Serverless, History and Evolution, Infrastructure-less management, Pay-per-use billing models, Scaling to Zero, BaaS vs. FaaS, Anatomy of a Function, Function triggers and bindings, Lifecycle of a Function, Cold Start vs. Warm Start optimization, Statelessness in FaaS, Global execution environments.

Unit-II: Serverless Architecture & Design Patterns

Event-driven Architecture, Event Sources (HTTP, S3, Database Streams), Design Patterns: Command, Messaging, and Fan-out/Fan-in, State management using External Caches (Redis/Memcached), Ephemeral storage vs. Persistent storage, Microservices vs. Serverless functions, Idempotency in function execution, Handling Timeouts and Retries.

Unit-III: Provider Ecosystem & Frameworks
AWS Lambda and Step Functions, Azure Functions and Durable Functions, Google Cloud Functions and Cloud Run, Open Source Serverless: Knative, Kubeless, and Apache OpenWhisk, Serverless on Kubernetes, The Serverless Framework (SLS), AWS SAM (Serverless Application Model), Deployment of multi-cloud serverless apps.

Unit-IV: Storage, Messaging & Orchestration
Serverless Databases: DynamoDB, Aurora Serverless, and Cosmos DB, Messaging services: SQS, SNS, and EventBridge, API Gateway management, Authentication and Authorization (JWT/OAuth), Throttling and Quotas, Workflow Orchestration, Service integration with legacy systems, Data consistency in distributed serverless systems.

Unit-V: Security, Observability & SPI Evolution 2026
Identity and Access Management (IAM), Principle of Least Privilege, API Security, Serverless Monitoring and Observability, Distributed Tracing (AWS X-Ray), AI-driven log analysis, CI/CD for Serverless, SPI Evolution 2026, Edge Computing delivery models (Lambda@Edge), The Shared Responsibility Model, Provider vs. customer duties across hybrid clouds.

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, Assignment I-V, Q, MST-I & II #)**
Weightage (%)	60	40

Examination Scheme: Total – 100 marks*A-Attendance; Assignment I-V (Class Assignment/Home Assignments/Case Discussions/Term Papers/Mini Project); Q-Quiz (5 Quizzes), MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

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4. **Serverless Architectures on AWS**, Peter Sbarski, Manning Publications, 2nd Edition, 2021.

Important Websites:

1. **Cloud Security Tutorial**, TutorialsPoint, https://www.tutorialspoint.com/cloud_computing/cloud_computing_security.htm, 2026.
2. **Introduction to Cyber Security**, GeeksforGeeks, https://www.geeksforgeeks.org/cloud-computing-security-challenges/, 2026.
3. **Cloud Computing and Distributed Systems**, Prof. Rajiv Misra, NPTEL (IIT Patna), https://nptel.ac.in/courses/106104182, 2026.
4. **AWS Cloud Security Concepts**, AWS Training Video, https://explore.skillbuilder.aws/learn/course/external/view/elearning/1927/aws-security-fundamentals, 2026
5. **Serverless Framework Documentation**, https://www.serverless.com/framework/docs, 2026.

BCA (System Administration and Cyber Security)
Detailed Syllabus

Semester – V
3SCS5-DE-002-T-01
Ethical Hacking
Pre-requisites: Basics of Computer Knowledge

Course Category			
L	**T**	**P**	**C**
4	0	0	4

Course Objective:

- To define the 2026 threat landscape, including AI-driven attacks, zero-day exploits, and MITRE frameworks.
- To explain advanced reconnaissance methodologies for Cloud, OSINT, and Active Directory environments.
- To demonstrate system exploitation, lateral movement, and MFA bypass techniques within controlled lab environments.
- To inspect modern web architectures, including APIs, GraphQL, and JWT sessions, for logical vulnerabilities.
- To construct defensive security postures using Honeypots, WPA3 hardening, and professional project documentation.

Course Outcomes:

Course Outcomes (COs)	**Level ***
CO1: Identify and categorize potential threats using the MITRE ATT&CK framework.	L2
CO2: Perform automated and manual footprinting to map a target's digital attack surface.	L2
CO3: Execute authorized attacks to gain system access and maintain persistence for testing.	L3 & L2
CO4: Analyze NLP parsing techniques and game-playing strategies like Minimax and Alpha-Beta pruning.	L4
CO5: Deliver a comprehensive Detailed Project Report (DPR) to validate internship completion.	L4 & L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3)*

–Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..

Articulation Matrix:-

(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	–	3	1	–	–	-	1	–	1	1	-
CO2	-	–	1		–	–	2	–	–	2	1	2
CO3	2	1	2		–	–	-	–	–	2	-	3
CO4	1	–	2	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	1	1	–	2	3	1

High-3 Medium-2 Low-1

Course Contents:

Unit-I: Ethical Hacking Overview, AI Threats & Threat Modeling

Overview of Security: Importance of cybersecurity in 2026, CIA Triad vs. Cyber Resilience, Concept of Ethical Hacking, Hacker types (White, Black, Gray Hat), Essential Terminologies: Threat, Attack Surface, Vulnerabilities (CVE/CVSS 4.0), Target of Evaluation, Exploit, Payload, Zero-Day. Phases involved in hacking: Reconnaissance, Scanning, Gaining Access, Maintaining Access, Clearing Tracks. Adversarial AI: Using LLMs for automated phishing and polymorphic malware, Cyber Kill Chain vs. MITRE ATT&CK Framework, Legal frameworks and DPDP Act 2026.

Unit-II: Advanced Footprinting, Port Scanning & Cloud Recon

Footprinting: Introduction, Information gathering methodology, OSINT 2.0, AI-powered reconnaissance tools (Shodan, Censys, Recon-ng), Meta-data extraction, Tracking digital footprints in Web3. Port Scanning: Introduction, TCP/UDP scanning, Advanced Nmap Scripting Engine (NSE), Stealth scanning (SYN, FIN, NULL, Xmas), Bypassing Firewalls and IDS/IPS. Scripting Enumeration: Enumerating Windows, Linux, and Active Directory, Cloud Enumeration: Hunting misconfigured S3 buckets, Azure Blobs, and Kubernetes (K8s) clusters.

Unit-III: System Hacking, Sniffing & Lateral Movement

System Hacking: Aspects of remote password guessing, Various methods of password cracking (Dictionary, Brute-force, Rainbow Tables), GPU-accelerated cracking with Hashcat, MFA (Multi-Factor) Bypass techniques, Stealing Session Tokens, Keystroke Loggers, Rootkits, and Fileless Malware. Understanding Sniffers: Active and Passive Sniffing, ARP Spoofing and Redirection, DNS Poisoning, DHCP Starvation. Encrypted Sniffing: HTTPS/SSL Stripping, Intercepting DNS over HTTPS (DoH), Traffic analysis in Zero-Trust Architectures, Lateral Movement: Pass-the-Hash (PtH) and Network Pivoting.

Unit-IV: Hacking Web Services, APIs & Session Hijacking

Web Application Vulnerabilities: OWASP Top 10 (2026 Update), Application coding errors, SQL Injection (Union, Error-based, Blind), NoSQL and GraphQL Injection, Cross-Site Scripting (Reflected, Stored, DOM-based), Cross-Site Request Forging (CSRF). Web Services Flaws: API Security (BOLA, Mass Assignment), SSRF (Server-Side Request Forgery) in Cloud Metadata, Protective HTTP Headers. Session Hijacking: Phases and Types

of Session Hijacking (Fixation, Sidejacking), JWT (JSON Web Token) Exploitation, Bypassing OAuth 2.0, Tools for session manipulation in SPAs.

Unit-V: Wireless, IoT Security & SDR Hacking
Introduction to Wireless: 802.11ax/be (Wi-Fi 6E & 7), Role of WEP/WPA2, WPA3-SAE (Dragonfly Handshake) vulnerabilities, Downgrade attacks. Wireless Hacking: Cracking WEP/WPA keys, Evil Twin attacks, Wireless DoS, WLAN Scanners, and Sniffers. IoT & Infrastructure: Hacking Zigbee, Bluetooth Low Energy (BLE), and Industrial IoT (IIoT), Software Defined Radio (SDR): Intercepting and replaying RF signals for smart locks and vehicle fobs. Securing Networks: Implementing WIPS, Deception Technology (Honeypots), and AI-driven Threat Hunting.

Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, Assignment I-V, Q, MST-I & II #)**
Weightage (%)	60	40

*A-Attendance; Assignment I-V (Class Assignment/Home Assignments/Case Discussions/Term Papers/Mini Project); Q-Quiz (5 Quizzes), MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

List of Books:

Textbook:

1. ***Hacking:*** *The Art of Exploitation, Jon Erickson, No Starch Press, 2nd Edition.*
2. ***The Basics of Hacking and Penetration Testing****, Patrick Engebretson, Syngress, 2nd Edition, 2013.*

Reference Books:

1. **RTFM: Red Team Field Manual, Ben Clark**, CreateSpace Independent Publishing Platform.
2. **Web Application Hacker's Handbook**, Dafydd Stuttard and Marcus Pinto, Wiley, 2nd Edition.
3. **Black Hat Python:** Python Programming for Hackers and Pentesters, Justin Seitz, O'Reilly Media, 2nd Edition, 2021.
4. **IoT Hackers Handbook**, Aditya Gupta, 1st Edition, 2019.
5. **Applied Cryptography**, Bruce Schneier, Wiley, 20th Anniversary Edition.

Important Websites:

1. **TryHackMe:** tryhackme.com
2. **OWASP Top 10 (2025/26 Updates):** owasp.org/www-project-top-ten
3. **NPTEL (Swayam Portal):** swayam.gov.in/explorer
4. **MITRE ATT&CK Framework:** attack.mitre.org

BCA (System Administration and Cyber Security)

	Course Category			
Semester – V				
3SCS5-DE-002-P-03	**L**	**T**	**P**	**C**
Data Mining & Warehousing Lab	0	0	4	2
Pre-requisites: None				

Course Objective:

- To explain the basic concepts, principles, and techniques of data mining.
- To apply data mining techniques to perform systematic analysis of real-world problems.
- To analyze data mining problems and interpret results using appropriate methods.
- To evaluate, visualize, and communicate statistical models effectively.
- To use data mining tools for data analysis and support data warehouse management..

Course Outcomes:

Course Outcomes (COs)	Level *
CO1: Explain the basic concepts, principles, and techniques of data mining.	L2
CO2: Apply data mining techniques to perform systematic analysis of real-world problems.	L2 & L3
CO3: Analyze data mining problems and interpret results using appropriate methods.	L4
CO4: Evaluate, visualize, and communicate statistical models effectively.	L4 & L5
CO5: Use data mining tools for data analysis and support data warehouse management.	L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..*

Articulation Matrix:-

(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	1	–	1	1	–	2	-	–	–	1	2	-
CO2	-	–	2		–	–	1	–	–	1	1	2
CO3	1	1	3		–	–	-	–	–	2	-	3
CO4	3	–	2	3	–	–	2	–	–	1	1	2
CO5	-	2	3	3	1	–	3	1	–	2	3	1

High-3 Medium-2 Low-1

List of Experiments:

1. OLTP vs. DWH (Banking): In a Bank, OLTP handles ATM withdrawals (fast, daily transactions), while DWH handles "Annual Credit Card Spend Analysis" (complex queries, historical data).
2. 3-Tier Architecture: * Bottom Tier: Data Warehouse Server (Data sources/Cleaned data).
    - Middle Tier: OLAP Server (Fast processing).
    - Top Tier: Front-end tools (Reporting/Mining).
3. Fact vs. Dimension (Retail): * Fact: Quantity_Sold, Total_Price, Discount.
    - Dimension: Product_Name, Store_Location, Customer_Name, Date.
4. ETL Transformation complexity: It's the "Heart" of ETL. It handles data cleaning, resolving format conflicts (e.g., Date as DD/MM vs MM/DD), and business logic.
5. Star Schema (University): Center has Fact_Results. Connected arms (Dimensions) are Students, Courses, Faculty, Semesters. It's simple because it requires only one join to get data.
6. Snowflake Schema: Normalize the Courses dimension into Course_Details and Department_Details. This reduces repeating department names, saving space.
7. Measures (Sales): * Semi-Additive: Account Balance (can sum across branches, but not across time).
    - Non-Additive: Profit Margin % or Unit Price (cannot be summed meaningfully).
8. Slice vs. Dice: * Slice: One slice of the cube (e.g., Sales for *only* the year 2023).
    - Dice: A sub-cube (e.g., Sales for *Bread* in *Delhi* during *Q1*).
9. Missing Values: Use Mean for normal data, Median if there are outliers, and Mode for categorical data (like "City").
10. Binning: Groups continuous values into "bins" (e.g., Ages 1–10, 11–20). It smooths out "noise" or minor errors in data.
11. Min-Max Calculation: To scale 50 (from range [20, 80]) to [0, 1]:

    $$\frac{50 - 20}{80 - 20} = \frac{30}{60} = 0.5$$

12. Reduction vs. Selection: Selection keeps the best original columns (e.g., keeping Income and dropping Eye Color). Reduction creates new variables (e.g., PCA) that combine old ones.
13. Euclidean Distance: For $P_1(2,3)$ and $P_2(5,7)$:

    $$\sqrt{(5-2)^2 + (7-3)^2} = \sqrt{3^2 + 4^2} = 5$$

    Significance: It measures how "similar" two customers or items are.
14. Log Transform: Used when data has a "long tail" (e.g., Income data where a few people earn millions) to make it look like a Bell Curve.
15. Support & Confidence: If {Bread, Butter} appears in 3 out of 10 bills: Support = 30%. If {Bread} appears in 6 bills: Confidence = 3/6 = 50%.
16. Apriori Manual Step: 1. Count frequency of single items. 2. Remove those below Min_Support. 3. Join remaining items to make pairs. 4. Repeat.
17. FP-Growth Advantage: Apriori is slow because it "generates candidates" (millions of pairs). FP-Growth uses a "Tree" and never generates candidates, making it much faster.
18. Maximal vs. Closed: Maximal means none of its immediate supersets are frequent. Closed means none of its supersets have the *same* support count.
19. Apriori Property: "If an itemset is infrequent, all its supersets are also infrequent." (e.g., If no one buys 'Milk', no one will buy 'Milk + Diamond rings').
20. Root Node: The attribute with the Highest Information Gain (lowest impurity) becomes the root (starting point).
21. Gini vs. Entropy: Gini is faster to calculate (used by CART). Entropy uses logarithms and is slightly more mathematically intense (used by ID3).
22. Naïve Bayes: It assumes attributes are independent. (e.g., "Red color" of a fruit has nothing to do with its "Round shape"). It makes the math simple.
23. Choice of K: If K is too small (e.g., 1), the model is sensitive to noise (Overfitting). If K is too large, it might include points from other groups (Underfitting).
24. Overfitting vs. Underfitting: Overfitting is like "memorizing" the textbook but failing the exam. Underfitting is "not studying enough" at all.
25. Confusion Matrix: * Precision: Correct Positive / Total Predicted Positive.
    - Recall: Correct Positive / Total Actual Positive.
26. K-Means Steps: 1. Pick 3 random centers. 2. Assign points to nearest center. 3. Calculate the average of the group to find new centers. 4. Repeat.
27. Elbow Method: Plot "Error" vs "Number of Clusters". The point where the graph bends sharply (like an elbow) is the best K.
28. Agglomerative vs. Divisive: Agglomerative starts with each point as its own cluster and joins them. Divisive starts with one big cluster and splits it.
29. PAM Robustness: K-Means uses the "Average" (sensitive to outliers). PAM uses an actual data point (Medoid) as the center, so outliers don't pull the center away.
30. Outlier Detection: * Fraud Detection: Finding a $10 Lakh transaction on a card that usually spends $1000.
    - Fault Detection: Finding a machine sensor reading 500°C when others read 50°C.

Examination Scheme: Total – 100 marks

Components Continuous	**External Assessment**	**(A, LR, MST-I & II #)**

Internal Assessment*	**(EST #)**	
Weightage (%)	50	50

*A-Attendance; Lab Record Submission, MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

List of Books:

Textbook:

1. **Data Mining-Concepts and Techniques-** Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006.
2. **Introduction to Data Mining,** Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.

Reference Books:

1. **Data Mining Techniques**, Arun K Pujari, 3rd Edition, Universities Press.
2. **Data Ware Housing Fundamentals**, Pualraj Ponnaiah, Wiley Student Edition.

Important Websites:

1. **NPTEL (https://www.nptel.com**
2. **Coursera (https://www.coursera.com)**
3. **Javatpoint (https://www.javatpoint.com)**
4. **Simplilearn (https://www.simplilearn.com)**

BCA (System Administration and Cyber Security)

Semester – V
3SCS5-DE-002-P-02
Server less Computing
Pre-requisites: None

Course Category			
L	**T**	**P**	**C**
0	0	4	2

Course Objective:

- To explain the shift from traditional infrastructure management to event-driven FaaS (Function-as-a-Service) models.
- To design Secure serverless applications by applying the Shared Responsibility Model to divide duties between provider and user.
- To implement zero Trust policies and AI-driven monitoring tools to protect cloud-native environments.
- To analyze the SPI Evolution 2026 and its specific impact on the delivery of Edge and Hybrid cloud services.
- To evaluate the efficiency of automatic scaling and pay-per-use billing compared to traditional cloud hosting.

Course Outcomes:

Course Outcomes (COs)	Level *
CO1: Explain the core concepts of **FaaS, BaaS**, and SPI evolution to manage automatic scaling and network security policies.	L2
CO2: Design secure cloud architectures using **IAM** and **Least Privilege** principles to maintain the CIA triad and restrict unauthorized access.	L2
CO3: Apply modern vulnerability scanning and **digital forensics** techniques to investigate attacks and navigate security challenges in serverless apps.	L3
CO4: Analyze the division of provider vs. customer duties within **Hybrid and Multi-cloud** environments to manage shared responsibility risks.	L4
CO5: Troubleshoot security and performance issues within modern **Edge Computing** delivery models and manage serverless execution risks.	L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..*

Articulation Matrix:-

(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	–	1	1	–	–	-	–	–	1	1	-
CO2	-	–	2		–	–	1	–	–	2	1	2
CO3	2	1	3		–	–	-	–	–	2	-	3
CO4	1	–	2	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	1	1	–	2	3	1

High-3 Medium-2 Low-1

List of Experiments:

1. Hello World Function: Create and deploy a basic function in a cloud environment (AWS Lambda/Azure).
2. Event Triggering: Automatically run a function when a file is uploaded to a cloud storage bucket (S3/Blob Storage).
3. API Integration: Use an API Gateway to create a public URL that triggers a serverless function.
4. Data Input Handling: Write a function that accepts user input and returns a custom response.
5. Environment Variables: Store and access sensitive data (like API keys) using environment variables.
6. Performance Testing: Measure the "Cold Start" vs. "Warm Start" latency of a serverless function.
7. System Logging: Use cloud logs to track execution and debug intentional errors in code.
8. Database Connection: Connect a function to a NoSQL database (like DynamoDB) to store records.
9. CRUD Implementation: Develop functions to Create, Read, Update, and Delete data in a cloud database.
10. Image Processing: Build a function that creates a thumbnail version of an image upon upload.
11. Scheduled Automation: Set up a cron-job trigger to run a function at a specific time daily.
12. Secure Key Management: Retrieve database credentials from a dedicated Secret Manager service.
13. IAM Permissions: Configure a "Least Privilege" role for a function and test access restrictions.
14. API Key Security: Implement API Key requirements to prevent unauthorized access to a web endpoint.

15. JWT Authentication: Secure an API by requiring a valid JSON Web Token for every request.
16. Private Networking: Deploy a function inside a Virtual Private Cloud (VPC) to hide it from the public internet.
17. CORS Setup: Configure Cross-Origin Resource Sharing to allow secure browser-based API calls.
18. Traffic Throttling: Set concurrency limits to prevent a function from being overwhelmed by requests.
19. Distributed Tracing: Use tools like X-Ray to track how data flows through a multi-service architecture.
20. Error Notifications: Set up an automated alert system to send an email if a function fails.
21. Vulnerability Scanning: Use automated tools to check function code for security weaknesses.
22. Log Forensics: Analyze access logs to identify the source of suspicious or malicious traffic.
23. Root Cause Analysis: Investigate execution failures to determine if the cause is code, memory, or timeout.
24. Workflow Orchestration: Use Step Functions to connect multiple functions into a logical sequence.
25. Edge Execution: Deploy code at an "Edge" location to reduce latency for global users.
26. Infrastructure as Code: Deploy an entire serverless stack using a single configuration file (serverless.yml).
27. Automated CI/CD: Set up a pipeline to auto-deploy code changes from GitHub to the cloud.
28. Version Control: Use function aliases to run two different versions of a code simultaneously.
29. Hybrid Connectivity: Trigger a cloud function from a local on-premise server via a secure connection.
30. Cost Optimization: Analyze usage metrics to estimate and optimize the monthly bill of a serverless app.

Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, LR, MST-I & II #)**
Weightage (%)	50	50

*A-Attendance; Lab Record Submission, MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

List of Books:

Textbook:

1. **Cloud Security and Privacy**, Tim Mather and Subra Kumaraswamy, O'Reilly Media, 1st Edition, 2017.

Reference Books:

1. **Cloud Computing Security: Foundations and Challenges**, John R. Vacca, CRC Press, 2nd Edition, 2020.

2. **Practical Cloud Security: A Guide for Secure Cloud Design**, Chris Dotson, O'Reilly Media, 1st Edition, 2019.
3. **Virtualization Security: Protecting Virtualized Environments**, Dave Shackleford, John Wiley & Sons, 1st Edition, 2013.
4. **Serverless Architectures on AWS**, Peter Sbarski, Manning Publications, 2nd Edition, 2021.

Important Websites:

1. **Cloud Security Tutorial**, TutorialsPoint, https://www.tutorialspoint.com/cloud_computing/cloud_computing_security.htm, 2026.
2. **Introduction to Cyber Security**, GeeksforGeeks, https://www.geeksforgeeks.org/cloud-computing-security-challenges/, 2026.
3. **Cloud Computing and Distributed Systems**, Prof. Rajiv Misra, NPTEL (IIT Patna), https://nptel.ac.in/courses/106104182, 2026.
4. **AWS Cloud Security Concepts**, AWS Training Video, https://explore.skillbuilder.aws/learn/course/external/view/elearning/1927/aws-security-fundamentals, 2026.
5. **Serverless Framework Documentation**, https://www.serverless.com/framework/docs, 2026.

BCA (System Administration and Cyber Security)
Detailed Syllabus

Semester – V
3SCS5-DE-002-P-01
Ethical Hacking Lab
Pre-requisites: Basics of Computer Knowledge

Course Category			
L	**T**	**P**	**C**
0	0	4	2

Course Objective:

- To define the 2026 threat landscape, including AI-driven attacks, zero-day exploits, and MITRE frameworks.
- To explain advanced reconnaissance methodologies for Cloud, OSINT, and Active Directory environments.
- To demonstrate system exploitation, lateral movement, and MFA bypass techniques within controlled lab environments.
- To inspect modern web architectures, including APIs, GraphQL, and JWT sessions, for logical vulnerabilities.
- To construct defensive security postures using Honeypots, WPA3 hardening, and professional project documentation.

Course Outcomes:

Course Outcomes (COs)	**Level ***
CO1: Identify and categorize potential threats using the MITRE ATT&CK framework.	L2
CO2: Perform automated and manual footprinting to map a target's digital attack surface.	L2
CO3: Execute authorized attacks to gain system access and maintain persistence for testing.	L3 & L2
CO4: Analyze NLP parsing techniques and game-playing strategies like Minimax and Alpha-Beta pruning.	L4
CO5: Deliver a comprehensive Detailed Project Report (DPR) to validate internship completion.	L4 & L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3)*

–Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..

Articulation Matrix:-

(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	1	–	3	1	–	–	-	1	–	1	1	-
CO2	-	–	1		–	–	2	–	–	2	1	2
CO3	2	1	2		–	–	-	–	–	2	-	3
CO4	1	–	2	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	1	1	–	2	3	1

High-3 Medium-2 Low-1

List of Experiments:

1. **Virtual Lab Setup:** Installing Kali Linux and Windows 11 on a virtual machine.
2. **Advanced OSINT:** Collecting public information about a target using AI tools and social media.
3. **Google Dorking:** Using advanced search queries to find hidden files, logs, and admin pages.
4. **Network Scanning:** Using Nmap to identify open ports and active devices in a network.
5. **Service Discovery:** Detecting the version and type of software running on a server.
6. **Cloud Bucket Hunting:** Finding and scanning unsecured AWS, Azure, or Google Cloud storage.
7. **DNS Interrogation:** Listing all subdomains and DNS records of a target website.
8. **Password Brute-force:** Using Hydra to test multiple passwords on a login page.
9. **Hash Cracking:** Using Hashcat to convert encrypted passwords back into plain text.
10. **MFA Bypass Lab:** Testing techniques to bypass Multi-Factor Authentication (OTP/Tokens).
11. **ARP Spoofing:** Intercepting local network traffic between two devices (Man-in-the-Middle).
12. **DNS Spoofing:** Redirecting users from a real website to a fake phishing page.
13. **Packet Analysis:** Using Wireshark to read and analyze data packets moving through a network.
14. **System Backdoor:** Creating a hidden "backdoor" to maintain access to a target computer.
15. **Keylogging:** Recording every keystroke typed on a target machine for testing purposes.
16. **SQL Injection:** Extracting usernames and passwords from a website's database.
17. **XSS Attack:** Injecting malicious scripts into a website to steal user cookies.
18. **JWT Exploitation:** Manipulating login tokens (JSON Web Tokens) to gain admin privileges.
19. **API Hacking:** Testing hidden API endpoints for security flaws in mobile and web apps.
20. **SSRF Attack:** Tricking a server into accessing internal data that is not meant for the public.

21. **Insecure File Upload:** Uploading a "web shell" to a website to take full control of the server.
22. **Wi-Fi Password Cracking:** Practicing hacking techniques for WPA2 and WPA3 Wi-Fi networks.
23. **Evil Twin Attack:** Setting up a fake Wi-Fi hotspot to capture user credentials.
24. **IoT Device Sniffing:** Monitoring data sent by smart devices like cameras or smart bulbs.
25. **SDR Replay Attack:** Using Software Defined Radio to copy and replay signals from car remotes.
26. **Phishing Lab:** Creating a realistic-looking fake login page to test user awareness.
27. **Payload Binding:** Hiding a malicious file inside a normal photo or a PDF document.
28. **Active Directory Mapping:** Using BloodHound to find paths to the "Domain Admin" in a company network.
29. **Log Analysis:** Checking system logs after a hack to identify traces left behind.
30. **Final Reporting:** Compiling all findings into a professional **Detailed Project Report**.

Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, LR, MST-I & II #)**
Weightage (%)	50	50

*A-Attendance; Lab Record Submission, MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

List of Books:

Textbook:

1. ***Hacking:*** *The Art of Exploitation, Jon Erickson, No Starch Press, 2nd Edition.*
2. ***The Basics of Hacking and Penetration Testing****, Patrick Engebretson, Syngress, 2nd Edition, 2013.*

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2. **Web Application Hacker's Handbook**, Dafydd Stuttard and Marcus Pinto, Wiley, 2nd Edition.
3. **Black Hat Python:** Python Programming for Hackers and Pentesters, Justin Seitz, O'Reilly Media, 2nd Edition, 2021.
4. **IoT Hackers Handbook**, Aditya Gupta, 1st Edition, 2019.
5. **Applied Cryptography**, Bruce Schneier, Wiley, 20th Anniversary Edition.

Important Websites:

1. **TryHackMe:** tryhackme.com
2. **OWASP Top 10 (2025/26 Updates):** owasp.org/www-project-top-ten
3. **NPTEL (Swayam Portal):** swayam.gov.in/explorer

4. **MITRE ATT&CK Framework:** attack.mitre.org

BCA (System Administration and Cyber Security)

Semester – V
3SCS5-DC-001-T
Java Programming
Pre-requisites: Basic Knowledge of Programming

Course Category			
L	**T**	**P**	**C**
4	0	0	4

Course Objective:

- To explain fundamental concepts of Java programming and object-oriented principles.
- To apply classes, objects, and methods in Java program development.
- To analyze Java Collection Framework and interface concepts.
- To implement packages, exception handling, and multithreading in Java applications.
- To develop GUI-based applications using event handling and Swing/AWT components.

Course Outcomes:

Course Outcomes (COs)	Level *
CO1: Explain Java programming fundamentals and object-oriented concepts	L2
CO2: Apply classes, objects, methods, and inheritance in Java programs	L3
CO3: Analyze collection framework and interface mechanisms in Java	L2 & L3
CO4: Implement packages, exception handling, and multithreading concepts	L2 & L3
CO5: Develop GUI applications using event handling and Swing/AWT components	L4 & L5

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Apply; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..*

Articulation Matrix:-
(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	1	–	1	2	–	–	-	–	–	1	1	-
CO2	-	–	2		–	–	1	–	–	1	2	2
CO3	1	1	3		–	–	-	–	–	2	-	3
CO4	3	–	1	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	3	1	–	2	3	1

High-3 Medium-2 Low-1

Course Contents:

Unit-: Introduction to Java :
Introduction to Java, History of Java: Comparison of Java and C++, Java as an object-oriented language: Java Features, JDK, JRE, Java virtual Machine, comments, Data types, Operators, Operators precedence and associativity, escape sequences, Type casting, Type Conversion The decision making–if, if.... else, switch, loops–for, while, do...while, special statements–return, break, continue, labeled break, labeled continue, arrays, keywords.

Unit-II: CLASSES, OBJECTS AND METHODS :
Introduction; Defining a Class; Adding Variables; Adding Variables; Adding Methods; Creating Objects; Accessing Class Members; Constructors; Methods Overloading; Static Members; Nesting of Methods; Inheritance: Extending a Class; Overriding Methods; Final Variables and Methods; Final Classes; Finalizer Methods; Abstract Methods and Classes; Visibility Control, Math class, Random Class

Unit-III: Collection framework :
LinkedList –HashSet, TreeSet, Hashtable, Strings, String functions, ArrayList, Traversing an ArrayList: using for-each loop, Iterator, ListIterator, Wrapper Classes, Auto Boxing and Unboxing. INTERFACES: Introduction; Defining Interfaces; Extending Interfaces; Implementing Interfaces; Accessing Interface Variables, Implementing Multiple Inheritance using Interfaces.

Unit-IV: PACKAGES :
Introduction; System Packages; Using System Packages; Naming Conventions; Creating Packages; Accessing a Package; Using a Package; Adding a Class to a Package; Hiding Classes.
Multithreading and Exception Handling: Basic idea of multithreaded programming, the lifecycle of a thread, creating thread with the thread class and runnable interface, Basic idea of exception handling, the try, catch and throw, throws and finally in exception handling.

Unit-V: Event Handling:
Delegation Event Model, Events, Event classes, Event listener interfaces, Using delegation event model, adapter classes and inner classes. Abstract Window Toolkit: Window Fundamentals, Component, Container, Panel, Window, Frame, Canvas. Components – Labels, Buttons, Check Boxes, RadioButtons, Choice Menus, TextFields, Text, ScrollingList, Scrollbars, Panels, Frames. Layouts: Flow Layout, Grid Layout, Border Layout, Card Layout
Swings: Classes, Working with JFrame Windows, Working with Graphics, Working with Colour, Adding and Removing Controls, Responding to Controls, Labels, Buttons, Checkbox, Checkbox Group, Choice Control, Lists, Text Field, Text Area. Menus, Dialog

Box, Handling Events.

Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, Assignment I-V, Q, MST-I & II #)**
Weightage (%)	60	40

*A-Attendance; Assignment I-V (Class Assignment/Home Assignments/Case Discussions/Term Papers/Mini Project); Q-Quiz (5 Quizzes), MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

List of Books:

Textbook:

1. **Spring Boot in Action**, Craig Walls, Manning Publications, 5th Edition, 2016.

Reference Books:

1. **Java: The Complete Reference**, Herbert Schildt, McGraw-Hill Education, 12th Edition, 2021.
2. **Head First Java**, Kathy Sierra, Bert Bates, and Trisha Gee, O'Reilly Media, 3rd Edition, 2022.
3. **Effective Java**, Joshua Bloch, Addison-Wesley Professional, 3rd Edition, 2018.

Important Websites:

1. **Java Programming Tutorial**, JavaTpoint, https://www.javatpoint.com/java-tutorial, 2026.
2. **Spring Boot Framework Tutorial**, Baeldung, https://www.baeldung.com/spring-boot, 2026.
3. **Programming in Java**, Prof. Debasis Samanta, NPTEL (IIT Kharagpur), https://nptel.ac.in/courses/106105191, 2026.

BCA (System Administration and Cyber Security)

Semester – V
3SCS5-DC-001-P
Java Programming
Pre-requisites: Basic Knowledge of Programming

Course Category			
L	**T**	**P**	**C**
0	0	4	2

Course Objective:

- To explain fundamental concepts of Java programming and object-oriented principles.
- To apply classes, objects, and methods in Java program development.
- To analyze Java Collection Framework and interface concepts.
- To implement packages, exception handling, and multithreading in Java applications.
- To develop GUI-based applications using event handling and Swing/AWT components.

Course Outcomes:

Course Outcomes (COs)	**Level ***
CO1: Explain Java programming fundamentals and object-oriented concepts	L2
CO2: Apply classes, objects, methods, and inheritance in Java programs	L2
CO3: Analyze collection framework and interface mechanisms in Java	L2, L3
CO4: Implement packages, exception handling, and multithreading concepts	L2, L3
CO5: Develop GUI applications using event handling and Swing/AWT components	L3, L4

**Level of Learning: Level 1 (L1) - Remember ; Level 2 (L2) – Understand; Level 3 (L3) –Applye; Level 4 (L4) –Analyze; Level 5 (L5) -Evaluate;.Level 6 (L6) -Create. Mention the highest level that will be attained in the Course Outcome..*

Articulation Matrix:-
(Program Articulation Matrix is formed by the strength of the correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	1	–	1	1	–	–	-	–	–	1	1	-
CO2	-	–	2		–	–	1	–	–	1	1	2
CO3	2	1	3		–	–	-	–	–	2	-	3
CO4	3	–	2	3	–	–	2	–	–	1	1	2
CO5	2	2	3	3	1	–	3	1	–	2	3	1

High-3 Medium-2 Low-1

List of Experiments:

1. Hello World & Data Types: Write a program to display your details and perform basic arithmetic operations using different data types.
2. Operator Precedence: Create a program to demonstrate the use of various operators and their precedence.
3. If-Else: Write a program to find the largest of three numbers using nested if-else.
4. Switch Case: Create a calculator using a switch statement.
5. Loops (While/For): Write a program to check if a number is Prime or Fibonacci.
6. Labeled Break/Continue: Demonstrate the use of labeled break and continue in nested loops.
7. Arrays: Write a program to find the sum and average of elements in a 1D array.
8. Class & Object: Create a Student class with variables (name, roll no) and methods to display data.
9. Constructor Overloading: Implement a program showing default and parameterized constructors.
10. Method Overloading: Write a program to calculate the area of different shapes using method overloading.
11. Static Members: Demonstrate the use of static variables and static methods (e.g., a counter for objects).
12. Inheritance: Implement Single Inheritance (e.g., Animal -> Dog) and use the super keyword.
13. Method Overriding: Create a program to demonstrate method overriding with final keywords.
14. Abstract Class: Create an abstract class Shape with an abstract method draw().
15. Interfaces: Implement Multiple Inheritance using Interfaces.
16. ArrayList: Create an ArrayList of Strings, add elements, and traverse it using an Iterator.
17. HashSet vs TreeSet: Write a program to show the difference between HashSet (unordered) and TreeSet (sorted).
18. Strings: Demonstrate various String functions like length(), concat(), substring(), and indexOf().
19. Wrapper Classes: Show the concept of Auto-boxing and Unboxing with integers.
20. Packages: Create a user-defined package and import it into another class.
21. Multithreading (Thread Class): Create a thread by extending the Thread class.
22. Multithreading (Runnable): Create a thread by implementing the Runnable interface.
23. Exception Handling (Try-Catch): Write a program to handle ArithmeticException and ArrayIndexOutOfBoundsException.

24. Custom Exception: Demonstrate the use of throw, throws, and finally keywords.
25. AWT Components: Create a simple AWT window with a Label, Button, and TextField.
26. Layout Managers: Demonstrate BorderLayout and GridLayout in a JFrame.
27. Event Handling: Create a "Click Me" button that changes the background color when clicked (Delegation Event Model).
28. Swing Login Form: Design a simple Login Form using JFrame, JTextField, JPasswordField, and JButton with basic event handling.

.Total: 60 Hours

Examination Scheme: Total – 100 marks

Components Continuous Internal Assessment*	**External Assessment (EST #)**	**(A, LR, MST-I & II #)**
Weightage (%)	50	50

*A-Attendance; Lab Record Submission, MST-I, MST-II, EST. (# MST-I & IIconducted at Department Level & EST (External Assessment) will be conducted by the CoE office at MU).

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3. **Programming in Java**, Prof. Debasis Samanta, NPTEL (IIT Kharagpur), https://nptel.ac.in/courses/106105191, 2026.