



Koneru Lakshmaiah Education Foundation

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Campus: Green Fields, Vaddeswaram - 522 302, Guntur District, Andhra Pradesh, INDIA.

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Department of Computer Science & Applications Minutes of 13th Board of Studies Virtual Meeting

The Department of Computer Science & Applications called for the 13th Board of Studies (BOS) meeting, scheduled to take place on the 13th August, 2025, starting from 4:00 P.M onwards.

Members Attended:

1. Dr. K. Bhagavan - Chairperson
2. Dr. E.Suresh Babu- External Academic Expert, NIT, Warangal.
3. Smt. Siva Leela - External Industry Expert, Hexaware, Chennai
4. Dr. V. S. Bhagavan - Professor, Department of Mathematics
5. Dr. P. Bindu Madhavi - CDOE
6. Dr. P. Srinivasa Reddy - KLH-Borampet
7. Dr. D. S. Rao - KLH-Aziz Nagar
8. Dr. K. Kiran Kumar - Professor
9. Dr. C. M. Sheela Rani - Professor
10. Dr. V. Valli Mayil - Professor
11. Dr. MNV Kiran Babu - Associate Professor
12. Dr. B. Mouleswararao - Associate Professor
13. Dr. V. S. Narayana Tinnaluri - Associate Professor
14. Dr. Y. Rama Krishna - Assistant Professor
15. Dr. Chunduri Kiran Kumar - Assistant Professor
16. Mr. A. Siddhartha Reddy - Assistant Professor
17. Dr. N. Venkata Ramana - Assistant Professor
18. Dr. Jeevan Jala - Assistant Professor
19. Mrs. T. Ratna Kumari - Assistant Professor
20. Dr. Ch. Madhava Rao - Assistant Professor
21. Dr. M. Ragini - Assistant Professor
22. Mrs. V. Swathi - Assistant Professor
23. Mrs. T. Hema Latha - Assistant Professor
24. R. Lalith Kumar – 3rd Year Student Representative (BCA)
25. Syed Arafath Ali – 3rd Year Student Representative (BCA)
26. Kotaru Lakshmi Sowmya - 2nd Year Student Representative (MCA)
27. Dasari Subha Sri - 2nd Year Student Representative (MCA)

Opening Remarks

Dr. K. Bhagavan, Chairperson and HOD-CSA welcomed all attendees and opened the meeting online.


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Agenda 1: Review and Approval of Previous Meeting Minutes

Discussion:

- Confirmed accuracy of documented action items from the last meeting.
- Allowed participants to share additional comments or concerns.
- Encouraged suggestions for improving the documentation and approval process.

Recommendations:

- **Dr. E. Suresh Babu** suggested incorporating a tracking mechanism for action items in future meetings.
- **Dr. V.S. Bhagavan** recommended including a summary of key decisions in each meeting minute.

Action Taken:

- The minutes of the previous meeting were reviewed and approved unanimously.

Agenda 2: Discussion on Key Decisions and Recommendations by the DAC on BCA Courses.

Discussion:

- Reviewed key decisions and recommendations made by the **Department Academic Committee (DAC)**.
- Evaluated suggestions for curriculum enhancement, faculty development, and industry collaborations.
- Discussed strategies for improving student engagement, research opportunities, and employability.

Recommendations:

- Faculties **Dr. Sabena banu** and **Dr Chandra Bhushan** suggested to include few AI related courses in the curriculum of BCA from Y25 regulation.
- **Smt. Sri Leela**, Industrial peer suggested to include a course to give the knowledge on the concepts of block chain and Fintech.
- **Dr. E. Suresh Babu**, Academic Peer proposed a course on Full Stack Application Development and on cloud platform.
- Faculty **Mrs. Ratna Kumari** suggested to include a course that showcases the front end development frame work which is useful to students.
- Faculty **Dr. Y.Rama Krishna** suggested to introduce "International Relations" as an Open Elective for BCA students.

Action Taken:

- The committee decided to include "INTRODUCTION TO AI AND DATA SCIENCE" in 2nd year and "AI TOOLS FOR IT PROFESSIONALS" in 3rd year BCA from Y25 Regulation students.


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- The committee decided to include "FINTECH & BLOCKCHAIN DEVELOPMENT" from Y25 BCA Regulation students
- The committee decided to include "FULL STACK APPLICATION DEVELOPMENT" and "CLOUD INFRASTRUCTURE & SERVICES" from Y25 BCA Regulation students.
- The committee decided to include "FRONT END DEVELOPMENT FRAMEWORK UI DEVELOPMENT" from Y25 BCA Regulation students
- The committee decided to include "International Relations" as a Open Elective from Y23 Regulation onwards.
- **All the above initiatives are recommended for Academic Council approval [Annexure II]**

Agenda 3: Finalization of Key Decisions and Recommendations on the New MCA Curriculum.

Discussion:

Need to design and implement a **new MCA curriculum** aligned with industry needs, emerging technologies, and employability skills. Emphasis on industry relevance, technological integration, skill-based learning, flexibility in electives, and BCA-MCA progression.

Recommendations:

- DAC Committee recommended developing the new MCA curriculum entirely from scratch, ensuring industry alignment and academic rigor.
- Dr. Sabena Banu and Dr. Chandra Bhushan suggested including AI-related courses in BCA from Y25 regulation to create a strong foundation for MCA.
- Dr. E. Suresh Babu (Academic Peer) proposed introducing a course on Full Stack Application Development.
- Dr. Ch. Madhava Rao and Dr. Jeevan Jala suggested integrating modules on research ethics, scholarly publishing tools, and data analysis using Python/R.
- Mr. Rajesh Kumar (Industry Expert – TCS) recommended merging the existing Data Science and Artificial Intelligence specializations into a single specialization named "AI & Data Science" starting from Y25 batch.
- Dr. V.S. Narayana Tinnaluri and Mrs. V. Swathi suggested adding electives on UI/UX Design, Cybersecurity Fundamentals, Mobile Application Development, and Data Visualization Tools.
- Syed Arafath Ali and Kotaru Lakshmi Sowmya (Student Representatives) highlighted the need to include front-end development frameworks such as React, Angular, and Vue.js in suitable courses.
- DAC Committee proposed offering value-added certification courses in collaboration with NPTEL, Coursera, and Infosys Springboard.


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- DAC Committee suggested introducing skill-based modules such as Full Stack Development, Cloud Foundations, Cybersecurity Awareness, and Data Analytics using Python.
- Smt. Sri Leela (Industrial Peer) suggested adding a course on blockchain and fintech concepts.

Action Taken:

- Development of the new MCA curriculum initiated, with faculty task forces assigned specific responsibilities.
 - Syllabus and course structures under preparation for submission to the BoS.
 - Collaboration discussions in progress with NPTEL, Coursera, and Infosys Springboard for inclusion of certification programs.
 - AI-related and foundational courses integrated into the BCA Y25 regulation to ensure smooth academic progression.
 - Recommendations on new electives, frameworks, and specialization structure approved for inclusion in the curriculum design.
 - **All the above initiatives are recommended for Academic Council approval.**
- [Annexure II]

Agenda 4: Finalization of Key Decisions and Recommendations on Ph.D. Courses in Computer Science.

Discussion:

- Suggestions were received from faculty members to enhance the Ph.D. coursework in Computer Science with modules that strengthen research capabilities, technical skills, and future-readiness.

Recommendations

- Dr. Ch. Madhava Rao and Dr. Jeevan Jala proposed integrating modules on Research Ethics, Scholarly Publishing Tools, and Data Analysis using Python/R into the Ph.D. coursework.
- Dr. MNV Kiran Babu recommended including modules on Artificial Intelligence (AI), Machine Learning (ML), and Quantum Computing to align the program with emerging technological advancements.

Action Taken

- Recommendations accepted for inclusion in the revised Ph.D. coursework structure.
- **Forwarded for Academic Council approval. [Annexure III]**


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Agenda 5: Finalization of Key Decisions and Recommendations on introduction of new under graduate programs B.Sc. AI&ML and B.Sc. AI&DS.

Discussion:

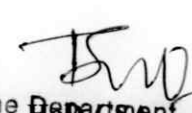
- Suggestions were received from Academic and Industry experts to introduce two undergraduate programs B.Sc. AI&ML and B.Sc. AI&DS to improve students technical and coding skills.

Recommendations

- **Dr. E. Suresh Babu**, Academic Peer proposed to introduce a new program on Artificial Intelligence a& Machine Learning.
- **Smt. Siva Leela**, Industry Expert proposed to introduce a new program on Artificial Intelligence & Data Science.

Action Taken

- Recommendations accepted for inclusion of new programs B.Sc. AI&ML and B.Sc. AI&DS from Y25 Regulation onwards..
- **Forwarded for Academic Council approval. [Annexure IV]**


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ANNEXURE I

DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS

25SDCA01R - FRONT END DEVELOPMENT FRAMEWORK UI DEVELOPMENT

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25SDCA01R	FRONT END DEVELOPMENT FRAMEWORK UI DEVELOPMENT	FEDFUI	R	1	0	0	4	2

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand foundational UI/UX design concepts, principles of effective UI.	3	PO1,PO2, PO3
CO2	Demonstrate the fundamentals of web development using HTML5, CSS3, JavaScript, responsive design principles.	3	PO1,PO3, PO4
CO3	Explain JavaScript and ES6+ features including arrow functions, let/const, restructuring, spread/rest, and modules.	4	PO4,PO5
CO4	Apply front-end frameworks and their use cases, compare React, Angular and with GitHub.	4	PO4,PO5
CO5	Experiment with User Interface Tool to develop an App or website pages and deploying applications.	4	PO3,PO4, PO5

Syllabus:

Introduction to UI/UX Design Concepts, Principles of Good UI Design, Tools for UI Design (Figma, Adobe XD, Sketch – Overview), Understanding User-Centered Design, Wireframes, Mockups, and Prototypes. Web Fundamentals, HTML5: Elements, Forms, Media, Semantics CSS3: Selectors, Box Model, Flexbox, Grid JavaScript Basics: Syntax, DOM Manipulation, Events Responsive Web Design (Media Queries, Mobile-First Design) CSS Frameworks: Bootstrap/Tailwind Overview. Advanced JavaScript and ES6+ Features, Arrow Functions, Let/Const, restructuring, Spread/Rest, Modules and Classes, Promises and Async/Await, Fetch API and AJAX, Local Storage and Session Storage. Introduction to Front-End Frameworks, Why Use Front-End Frameworks, Comparison: React vs Angular vs Vue.js. Project Setup and Tooling: Node.js, npm/yarn, Webpack/Vite Using Version Control: Git& GitHub Basics.

Reference Books:

Learning Web Design – Jennifer Niederst Robbins O'Reilly Media 2018, Eloquent JavaScript – Marijn Haverbeke No Starch Press 2021, React – Up & Running – Stoyan Stefanov O'Reilly Media 2020

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25CA2107-INTRODUCTION TO AI AND DATA SCIENCE

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA2107	INTRODUCTION TO AI AND DATA SCIENCE	AIDS	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the core AI concepts.	2	PO1, PO2, PO3
CO2	Use Python for different types of learning and NLP.	2	PO1, PO2, PO3
CO3	Understand basic concepts of data science	2	PO2, PO3
CO4	Apply different types of machine learning algorithms	3	PO2, PO3
CO5	Experiment with various cloud services using web services Cloud for building and deploying applications	3	PO2, PO3

Syllabus

Introduction: What is AI? Foundations of AI, History of AI, Agents and environments, the nature of the Environment, Problem solving Agents, Problem Formulation, Search Strategies, Knowledge and Reasoning: Knowledge-based Agents, Representation, Reasoning and Logic, Propositional logic, First-order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining. Learning: Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees, Why Learning Works, Learning in Neural and Belief networks. Practical Natural Language Processing: Practical applications, Efficient parsing, scaling up the lexicon, Scaling up the Grammar, Ambiguity, Perception, Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis. Evolution of Data Science, Introduction to Data Science – Types of Data, Data Science Vs Big Data, Concept of Big Data, Concept of Data Warehousing, Introduction to Data Mining, Role of Data Scientist, Data Science Life Cycle, Data Science Roles – Data Science Project Stages – Data Science Applications in Various Fields – Data Security Issues, thinking in a structured way to solve data science problem statements. Need of Data Pre-processing, Pre-processing of data and data collection, Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization, Data Storage, and management, Data preparation with Sandbox for analytics. Introduction to Data Analytics/Concept of Data Analytics Types of Data Analytics, Descriptive Statistics, Mean, Standard Deviation, Skewness, and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics, ANOVA, Exploratory Data Analytics, Confidence (statistical) intervals; variances and correlations. Simple and Linear Regression – Visual Model Evaluation – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – In-sample Evaluation Measures – Prediction and Decision Making Metrics for Out-of-Sample Evaluation Error – Cross Validation – Overfitting – Under fitting and Model Selection – Ridge Regression Prediction – Grid Search Testing Multiple Parameters

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Reference Books

1. "Data Science from Scratch" by Joel Grus
2. "Python Machine Learning" by Sebastian Raschka
3. "Artificial Intelligence: A Modern Approach" by Stuart Russell & Peter Norvig
4. Online Platforms: Coursera (IBM Data Science), Kaggle, edX, Fast.ai


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25SDCA04R - FULL STACK APPLICATION DEVELOPMENT

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25SDCA04R	FULL STACK APPLICATION DEVELOPMENT	FSAD	R	1	0	0	4	2

Pre-requisite

S#	Course Title	Acronym	Rule
1	OBJECT ORIENTED PROGRAMMING	OOP	1

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Develop a responsive frontend using React, Bootstrap, and modern JavaScript.	3	PO1,PO2, PO3
CO2	Apply the RESTful backend using Spring Boot and perform CRUD operations with MySQL.	3	PO1,PO2, PO3
CO3	Examine the communication between React frontend and Spring Boot backend using REST APIs.	4	PO2,PO3
CO4	Analyze the full-stack CRUD application, GitHub for version control and project management.	4	PO2,PO3
CO5	Develop a working full-stack CRUD project (e.g., User Manager app) which can be added to their portfolio.	5	PO2,PO3

Syllabus

Frontend Development: Overview of HTML, CSS, JavaScript for building web pages. Style UI with Bootstrap and create components using React. Understand props, state, events, and routing in React. Build a simple form-based UI with dummy data display.

Backend with Spring Boot and MySQL Set up Spring Boot project with required dependencies. Create REST APIs using controllers, services, repositories. Connect to MySQL using JPA and perform CRUD operations. Test backend using Postman and handle JSON data.

Frontend-Backend Integration: Connect React frontend with Spring Boot backend APIs.

Use fetch or axios to send and receive data. Submit forms and display real-time data from MySQL.

Handle CORS, errors, and loading states properly. Deployment and Final Project: Build and serve React app inside Spring Boot project. Deploy backend to Render or Railway, connect MySQL. Push code to GitHub and manage with Git commands. Complete a full-stack CRUD app like user manager.

Reference Books

1. Fullstack React – Accomazzo et al, Fullstack.io, 2021.
2. Spring Boot in Action – Craig Walls, Manning 2016.

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25SDCA05-CLOUDINFRASTRUCTURE & SERVICES

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25SDCA05	CLOUD INFRASTRUCTURE & SERVICES	CIS	R	1	0	0	4	2

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Introduction to Cloud Infrastructure and Virtualization	2	PO1, PO2
CO2	Illustrate Core Cloud Services – Compute, Storage, and Networking	2	PO1,PO2
CO3	Demonstrating the Infrastructure Provisioning, Automation, and Monitoring	2	PO2,PO3
CO4	Summarize Security, Compliance, and Integration in Cloud Environments	3	PO2,PO3
CO5	Analyse Cloud Deployment, DevOps Integration.	4	PO3,PO4

Syllabus

Cloud Computing Overview: Characteristics and benefits of cloud infrastructure, Service Models (IaaS, PaaS, SaaS), Deployment Models (Public, Private, Hybrid, Community) Cloud Infrastructure Architecture: Core components: Compute, Storage, Networking, Cloud data centers, Hyper-scale infrastructure. Virtualization Technologies: Types of hypervisors, Containerization (Docker, Kubernetes basics). Compute Infrastructure: Virtual Machines, Containers, Auto-scaling, Storage Services: Object, Block, and File Storage, Cloud Networking: Virtual Networks (VPC, Subnets, VPN), DNS, CDN (CloudFront, Azure CDN). Resource Provisioning: Infrastructure as Code (IaC): Introduction to Terraform, AWS CloudFormation, Automated deployment and scaling. Cloud monitoring tools (CloudWatch, Azure Monitor) Cloud pricing models, Budgets and cost optimization strategies, AWS Pricing Calculator, Azure Cost Management. Infrastructure Security: Identity & Access Management (IAM), MFA, Firewalls, Security Groups, Policies and auditing (AWS CloudTrail, Azure Policy), Integration with DevOps tools (CI/CD pipelines), Multi-cloud and Hybrid cloud infrastructure, Edge Computing. Application Deployment on Cloud Platforms: manual vs. automated, AWS Elastic Beanstalk, Azure App Services, Google App Engine, Deployment using containers and serverless architectures, Intrarchitectures, Introduction DevOps principles and culture, Benefits of DevOps in cloud environments, Role of cloud in enabling DevOps practices.

Reference Books

- Title:** Cloud Computing: Concepts, Technology & Architecture, **Authors:** Thomas Erl, Zaigham Mahmood, Ricardo Puttini **Publisher:** Prentice Hall (Pearson Education) **Year:** 2013
- Title:** Cloud Computing: Principles and Paradigms, **Auth Authors:** Rajkumar Buyya, James Broberg, Andrzej Goscinski, **Publisher:** Wiley **Year:** 2011

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25CA3111- AI TOOLS FOR IT PROFESSIONALS(R)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA3111	AI Tools for IT Managers	AITM	R	0	0	4	0	2

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand AI categories and identify strategic areas for AI Adoption in IT.	2	PO1,PO2, PO3
CO2	Use low-code AI tools for automation and process enhancement in business contexts.	3	PO1,PO2, PO3
CO3	Design effective prompts and apply LLM tools to automate routine IT workflows.	4	PO2,PO3
CO4	Evaluate and manage ethical risks associated with AI adoption in IT systems.	4	PO2,PO3

Syllabus

AI Fundamentals for Decision Makers: AI vs ML vs DL. Types of AI: narrow, general, strong. Real-world AI use cases in HR, finance, operations, marketing. Benefits, risks and limitations. Overview of AI adoption frameworks for business. AI Tools for Business Process Automation: Overview of low-code AI platforms: Microsoft Power Platform, Google Vertex AI, IBM Watson. Use of Zapier and Make for automation. Intro to RPA tools: UiPath, Automation Anywhere. Intelligent document processing tools. Prompt Engineering and LLM Tools: Prompt design for productivity tools (ChatGPT, Bard, Claude). Types of prompts: zero-shot, few-shot, chain-of-thought, role-based. Building internal copilots for IT tasks. Automating documentation, report writing, ticket handling with AI tools. Ethical AI Use and AI Governance in IT: Ethical AI principles, AI bias and explainability. AI governance frameworks (ISO/IEC 42001, NIST AI RMF). Risk assessment matrices. Responsible AI dashboards (Google What-If Tool, AI Fairness 360).

Reference Books

- 1) AI Superpowers – Kai-Fu Lee, Houghton Mifflin Harcourt, 2018
- 2) Responsible AI – Virginia Dignum, Springer, 2019
- 3) The Art of Prompt Engineering with ChatGPT – Nathan Hunter, Independently Published, 2023
- 4) Artificial Intelligence for Managers – Thomas H. Davenport, Harvard Business Review Press, 2020
- 5) AI Ethics – Mark Coeckelbergh, MIT Press, 2020

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25CA3213 FINTECH & BLOCKCHAIN DEVELOPMENT

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA3213	FINTECH & BLOCKCHAIN DEVELOPMENT	CA	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the concept of Fintech, its origin and evolution, and how Fintech solutions effectively address various challenges faced by customers and organizations	2	PO1
CO2	Apply business models, strategies, frameworks, tools & technologies to transform banks	3	PO1
CO3	Apply about the different types of Blockchain and consensus algorithms.	3	PO4
CO4	Apply the different types of crypto currencies & its importance and Blockchain applications	3	PO4

Syllabus:

Introduction to Fintech; What is Financial Technology, A Brief Background & History of Fintech, A Timeline & Journey Map, Rise of Fintech, Pillars, Drivers & Enablers of Fintech, Advantages & Risks associated with Fintechs. Understanding the problems in the world of Banking, Finance, Insurance; Identifying Problem Statements, Challenges faced by organizations; Customer Pain points, Customer Experience Curves, Area & Sector wise analysis. Fintech Strategies Introduction to Digital, Fintech & Technology Strategy, List of Strategic Frameworks & Models; Learning how to build strategies & frameworks, Tools used, Interpreting the Principles Disruptive Innovations Defining & Understanding Innovations; Types of Innovations, Disruptive Innovations, Innovation Cycle - Phases, Metrics, Components, Value Networks, Value Propositions, Identifying the points of disruption, Open Innovations. Basics of Blockchain concepts: Architecture – Properties of Blockchain – Distributed ledger – Merkle tree – structure of a Block – Smart contract – Crowd funding – Transaction – Double spending – Block propagation – Consensus Protocols – Proof of Work (PoW) – Proof of Stake (PoS) – Proof of Burn (PoB) – Proof of Elapsed Time (PoET) – PAXOS consensus – RAFT consensus – Delayed Proof of Work (dPoW) – Delegated Proof of Stake (DPoS) – Byzantine general problem – Byzantine Fault Tolerance (BFT) – Delegated Byzantine Fault Tolerance (dBFT) – Practical Byzantine fault tolerance Algorithm. Three phase commit Protocol – Mining. Types of Blockchain – Blockchain components – Permissioned Blockchain – Permissionless Blockchain – Consortium Blockchain. Cryptocurrencies: Cryptocurrencies applications using Blockchain – Bitcoin: Bitcoin properties – Transaction life cycle – creation of coin – sending payments – double spending using Blockchain – bitcoin anonymity. Applications of blockchain – Blockchain-based Internet of Things (BIIoT), Supply Chain Management and Healthcare etc.

Reference Books

Introduction to Fintech, 1st Edition | Technology In Specific Financial Process | Cutting-Edge Technology | - Pearson by Chandrahauns Chavan (Author), Atul Patankar (Author) Chandramouli Subramanian, Asha A George, Abhilash K A, Meena Karthikeyan, "Blockchain Technology", University Press (India) Private Limited, 2021

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23OEBA02 INTERNATIONAL RELATIONS

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
23OEBA02	INTERNATIONAL RELATIONS	IR	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the concept of International Relations	2	PO1.PO3
CO2	Understand the role of International Organizations	2	PO1.PO3
CO3	Understand the basic structure of Indian foreign policy	2	PO1.PO3
CO4	Understand the significant issues of Indian foreign policies	2	PO1.PO3

Syllabus:

Meaning, scope and nature of International Relations, Evolution of International Relations Emergence of nation states and nationalism, Power Politics: Balance of Power, Geopolitics, Bipolarity, Unipolarity, Multipolarity and Post-World War II Period (Cold War). CO 2-International Organizations and Global Governance, United Nations: Role, Relevance, and Reforms, SAARC, BRICS, G20, Global Governance: Issues and Challenges. CO 3-Determinants of India's Foreign Policy Mission and Objective of India's Foreign Policy, Evolution of India's Foreign policy, Institutional Framework of India's Foreign policy, Non-Alignment, Panchsheel Agreement, Look East Policy, 'Act East. Impact of LPG, Liberalization, Globalization and Privatization. CO 4- India and Pakistan, India- China, India-Bangladesh, India-Myanmar, India-Afghanistan, India-Sri Lanka, India-USA, India-USSR, Recent trends in India's foreign policy, and Major recent challenges in India's foreign policies.

Text Books :

- Vinay Kumar Malhotra, International Relations, Anmol Publications, New Delhi, 2016.
- Jacob Katz Cogen (eds.) The Oxford Handbook of International Organizations, Oxford University Press, UK, 2016
- V.N Khanna, Foreign Policy of India, Vikas Publishing House, New Delhi, 2018.

Reference Books : International relations the basics, Peter Sutch and Juanita Elias, Taylor and France Publishers, 2007

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ANNEXURE II

MASTER OF COMPUTER SCIENCE AND APPLICATIONS

25MT5101- MATHEMATICS FOUNDATIONS FOR COMPUTER SCIENCE (MFCS)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25MT5101	MATHEMATICS FOUNDATIONS FOR COMPUTER SCIENCE	MFCS	R	2	1	0	0	3

Course Outcomes

CO#	CO Description	BTL
CO1	Apply propositional and predicate logic to represent and analyze logical arguments using inference rules and equivalence laws.	3
CO2	Analyze and perform set operations, Venn diagrams, counting principles including permutations, combinations, and pigeonhole principle.	4
CO3	Apply number theory concepts such as divisibility, modular arithmetic, Euler's and Fermat's theorems in solving computational problems.	3
CO4	Analyze the structure and properties of groups and rings and demonstrate their application in cryptography and blockchain.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3			3
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.				
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2		3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			2	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures				

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	with ethical responsibility.				
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.				

Syllabus

Module 1: Propositional and predicate logic, logical equivalence, inference rules. Set theory: operations, Venn diagrams, Cartesian products. Counting principles: permutations, combinations, pigeonhole, inclusion-exclusion.

Module 2: Divisibility, GCD, Euclidean algorithm, modular arithmetic, Euler's theorem, Fermat's theorem. Basics of groups and rings. Hash functions and applications in cryptography and blockchain.

Module 3: Vectors, matrices, linear transformations, matrix operations, eigenvalues.

Graph types, trees,

shortest paths (Dijkstra), BFS/DFS, MST (Kruskal/Prim), graph applications in NLP and AI.

Module 4: Central tendency measures, Sample space, events, conditional probability, Bayes' theorem. Random variables, expectation, variance. Distributions (binomial, normal). Optimization (LP formulation, constraints).

References Books

Title	Publisher	Year
Discrete Mathematics and Its Applications – Kenneth H. Rosen	McGraw Hill Education	2017
Linear Algebra and Its Applications – Gilbert Strang	Cengage Learning	2016
Discrete Mathematics and Its Applications	Kenneth H. Rosen	2016
Discrete Mathematics with Applications	Susanna S. Epp	2018
Cryptography and Network Security: Principles and Practice	William Stallings	2016
Introduction to the Theory of Computation	Michael Sipser	2012
Linear Algebra and Its Applications	Gilbert Strang	2016

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25CA5101- OPERATING SYSTEMS

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA5101	OPERATING SYSTEMS	OS	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL
CO1	Understand the functional roles of modern OS in software and cloud systems.	2
CO2	Apply process and task management tools to enhance software workflows.	3
CO3	Use file systems, access control, and automation in cross-platform environments.	3
CO4	Integrate OS-level tools and practices in cloud-native and containerized environments.	4
CO5	Implement and evaluate processes, file systems, storage, virtualization technologies and optimize the infrastructure in modern IT environments.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3		3		3
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.					
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2		2	
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			2	3	3
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.					

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PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.					
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Syllabus

Module 1: OS Fundamentals for IT Systems, Operating System as a software platform

Types of OS (desktop, server, mobile, cloud-based), system services and interfaces, OS roles in distributed systems and cloud computing. Windows vs Linux vs macOS. Understanding shells, terminals, and role of OS in DevOps.

Module 2: Process and System Resource Handling

Process lifecycle, 5 state model, task management, thread concepts in IT systems, practical multitasking, resource allocation scenarios – CPU Scheduling, Deadlocks, system monitoring tools (top, htop, Task Manager), job scheduling in Linux/Windows. Process utilities and scripting (e.g., ps, kill, cron, PowerShell).

Module 3: File Systems, Storage, and Access

File and directory structures in Linux and Windows, permissions and security (ACLs, chmod, chown), mounting devices, working with file systems across platforms, FTP/SFTP/NFS, practical backup and automation using scripts. Disk utilities and storage tools for developers.

Module 4: OS in Modern IT Infrastructure

Containers and virtualization: introduction to Docker, WSL, VMs. System imaging, OS for cloud deployment (Amazon Linux, Ubuntu Server), OS tuning and automation using scripting tools. Basics of service management (systemd, services.msc), performance logging and diagnostics.

Reference Books:

Title	Publisher	Year
Operating Systems: Three Easy Pieces – Remzi H. Arpaci-Dusseau	Arpaci-Dusseau Books	2020
Linux Basics for Hackers – OccupyTheWeb	No Starch Press	2018
The Linux Command Line – William E. Shotts	No Starch Press	2019
Learning the bash Shell – Cameron Newham	O'Reilly Media	2017
Docker Deep Dive – Nigel Poulton	Independently Published	2021


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25CA5208- PROBLEM SOLVING THROUGH PROGRAMMING

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA5208	PROBLEM SOLVING THROUGH PROGRAMMING	PSP	R	3	0	2	2	4.5

Course Outcomes

CO#	CO Description	BTL
CO1	Write structured programs using control structures and syntax rules	2
CO2	Solve problems using modular programming, string, and list operations	3
CO3	Use data structures and file operations in real-world computing scenarios.	3
CO4	Apply logical thinking to solve computing problems through code.	4
CO5	Implement python programming concepts to solve problems on list, files, tuples, dictionaries	4
CO6	Develop solutions for real world problems using python	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	C01	C02	C03	C04	C05	C06
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	2		2		2	
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.	2	2		2		2
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.	2	2				
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			2	2	3	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.						3

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Syllabus

Module 1: Fundamentals of Programming:

Introduction to programming, data types, variables, operators, control structures (if, for, while), input/output operations. Debugging practices, code documentation. Python syntax, indentation, style guide (PEP8).

Module 2: Functions, Strings & Lists:

Function definition, parameters, return values, recursion. Strings and manipulations, slicing, built-in methods. Lists, list operations, comprehensions. Practical examples in data parsing and manipulation.

Module 3: Data Structures & File Handling:

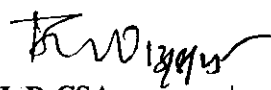
Tuples, sets, dictionaries, nesting, and their use cases. File handling (read/write/append), working with paths, handling exceptions, working with CSV and JSON files.

Module 4: Algorithmic Thinking:

Problem decomposition, trace tables, test case design, debugging techniques, refactoring. Hands-on challenges: sorting, searching, and basic algorithms.

Reference Books:

Title	Publisher	Year
Python Programming: An Introduction to Computer Science – Zelle	Franklin, Beedle & Associates	2017
Automate the Boring Stuff with Python – Al Sweigart	No Starch Press	2019
Think Python – Allen B. Downey	O'Reilly Media	2021
Programming in Python 3 – Mark Summerfield	Addison-Wesley	2020
Python Crash Course – Eric Matthes	No Starch Press	2022


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25CA5103 - COMPUTER NETWORKS & SECURITY (CNS)

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA5103	Computer Networks & Security	(CNS)	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL
CO1	Understand and use core networking concepts and tools in IT environments.	2
CO2	Configure, secure, and troubleshoot networks using system tools.	3
CO3	Analyze and manage enterprise-grade cloud and virtual network solutions.	4
CO4	Apply essential security practices and tools to protect networks and data.	3

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	2			2
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.		3		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.			3	
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3	3	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.	2			
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.				2

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Syllabus

Module 1: Foundations of Networking:

Network types (LAN, WAN, PAN, MAN), OSI & TCP/IP models (functional overview), IP addressing (IPv4/IPv6), MAC, DNS, DHCP, NAT, routing vs switching, sub-netting tools. Tools: ipconfig, ping, tracert, nslookup, nmap.

Module 2: Network Configuration & Troubleshooting:

Basics of network cabling, wireless networks, configuring routers, switches, and firewalls. Troubleshooting connectivity issues. Tools: Wireshark, Packet Tracer, netstat, firewall config, SSH, RDP.

Module 3: Enterprise and Cloud Networking:

Virtual networking in cloud (VPC, Azure VNets), DNS zones, load balancers, NAT gateways. VPN, tunneling, SDN, zero-trust networking. Configuring public/private subnets. Cloud monitoring tools.

Module 4: Network Security Fundamentals:

Cybersecurity principles, firewalls, IDS/IPS, endpoint protection, HTTPS, SSL/TLS, VPN security. Threats: phishing, DDoS, MITM, ransomware. Tools: iptables, fail2ban, antivirus, MFA.

Reference Books:

Title	Publisher	Year
Computer Networking: A Top-Down Approach – Kurose & Ross	Pearson	2021
Network Security Essentials – William Stallings	Pearson	2022
Practical Packet Analysis – Chris Sanders	No Starch Press	2017
Hands-On Networking Fundamentals – Michael Palmer	Cengage Learning	2019
Cybersecurity Essentials – Charles J. Brooks et al.	Wiley	2020

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25CA5104 - ARTIFICIAL INTELLIGENCE

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA5104	ARTIFICIAL INTELLIGENCE	AI	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL
CO1	Understand basic AI paradigms and apply search-based problem solving.	2
CO2	Apply knowledge representation for building rule-based intelligent systems.	3
CO3	Use AI libraries and cloud APIs to build intelligent applications.	3
CO4	Analyze and apply AI solutions to automate business and IT workflows.	4

Program Outcomes & Program Specific Outcomes

PO/P SO	PO/PSO Description	CO 1	CO 2	CO 3	CO 4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	2	3	3	
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.				
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.			3	2
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			3	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.				2

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Syllabus

Module 1: Definitions and types of AI (narrow, general, strong), intelligent agents, AI in business & IT operations. Search techniques: uninformed (BFS, DFS), informed (greedy, A*), problem formulation, real-world decision-making examples.

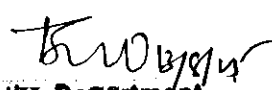
Module 2: Knowledge bases, logic-based reasoning (propositional, predicate), rule-based systems, ontologies, semantic web. Case studies in chatbots, recommendation systems, expert systems, and diagnostics.

Module 3: Supervised vs unsupervised learning, classification, clustering, regression (conceptual). AI tools: Python, scikit-learn, TensorFlow Lite, Hugging Face APIs, Google AI tools, Azure Cognitive Services.

Module 4: AI in automation, data processing, anomaly detection, customer service (chatbots), voice and vision APIs, document understanding, RPA. Real-world use cases from IT helpdesk automation, HR tech, and healthcare AI.

Reference Books:

Title	Publisher	Year
Artificial Intelligence: A Modern Approach – Russell & Norvig	Pearson	2020
Practical AI on the Google Cloud Platform – Micheal Lanham	Apress	2020
Python Machine Learning – Sebastian Raschka	Packt	2022
Applied Artificial Intelligence – Mariya Yao, Adelyn Zhou, Marlene Jia	Wiley	2018
Hands-On Artificial Intelligence for Beginners – Patrick D. Smith	Packt	2023


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25CA5105 - OBJECT ORIENTED PROGRAMMING

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA5105	OBJECT ORIENTED PROGRAMMING	OOP	R	3	0	2	2	4.5

Course Outcomes

CO#	CO Description	BTL
CO1	Apply foundational OOP concepts to structure Java applications	3
CO2	Use Java collections effectively for real-world data manipulation.	3
CO3	Implement functional style programming using lambdas and Stream API	4
CO4	Build multithreaded and event-driven interfaces using Java.	4
CO5	Apply OOP, collections, functional programming, and multithreading in Java to build efficient and modular real-world applications.	4
CO6	Design and implement Java-based applications by applying OOP principles, data structures, functional programming, and multithreading to solve real-world problems with hands-on coding skills.	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	C01	C02	C03	C04	C05	C06
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.						
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.						
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.	3	3	2	3		
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3	3	3	3	3
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal					2	2

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	skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.						
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.					2	

Syllabus

Module 1: Java class structure, objects, constructors, access modifiers, encapsulation, 'this' and 'static', method overloading. Inheritance types, polymorphism, abstract classes, interfaces, overriding, exception Handling.

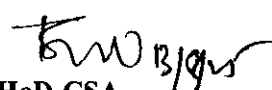
Module 2: Java Collections Framework (List, Set, Map), Generics, Iterable and Iterator, comparable vs comparator, utility classes (Collections, Arrays), usage of ArrayList, LinkedList, HashMap, TreeSet.

Module 3: Lambda expressions, functional interfaces (Function, Predicate, Consumer), method references, Stream API for filter-map-reduce, Optional class, best practices for clean functional code.

Module 4: Thread creation via Thread class and Runnable, thread lifecycle, synchronization, inter-thread communication (wait/notify), Executor framework. Basics of event handling in Swing/JavaFX.

Reference Books:

Title	Publisher	Year
Effective Java – Joshua Bloch	Addison-Wesley	2018
Core Java Volume I – Cay S. Horstmann	Pearson	2021
Java: The Complete Reference – Herbert Schildt	McGraw Hill	2022
Head First Java – Kathy Sierra, Bert Bates	O'Reilly Media	2022
Java Concurrency in Practice – Brian Goetz	Addison-Wesley	2006


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25CA5206 - SOFTWARE ENGINEERING

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA5206	SOFTWARE ENGINEERING	SE	R	2	1	0	0	3

Course Outcomes

CO#	CO Description	BTL
CO1	Understand and document software requirements using standard SDLC approaches	2
CO2	Apply object-oriented and architectural design principles using UML.	3
CO3	Practice agile software development and DevOps fundamentals.	3
CO4	Evaluate software quality and estimate project effort using appropriate metrics	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	2			
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.				
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2	2	3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			3	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				3
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.				

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Syllabus

Module 1: Introduction to SDLC models: Waterfall, Iterative, Spiral, V-model, Agile. Requirements engineering: elicitation techniques, functional vs non-functional requirements. Feasibility study, SRS

documentation, use case modeling.

Module 2: Modular design, cohesion and coupling, abstraction, information hiding. UML diagrams: use case, class, sequence, activity, state, component. Architecture patterns: layered, client-server, MVC.

Design documentation standards.

Module 3: Agile manifesto and principles. Scrum framework: roles, ceremonies, artifacts. User stories, product and sprint backlog, FDD, Lean Software Development, KANBAN, SAFe Methodology.

Module 4: Software Testing: unit, integration, system, acceptance. Testcases, test coverage, TDD.

Quality assurance: reviews, audits. Software metrics: LOC, cyclomatic complexity, defect density. The Human and The Computer, Golden Rules, Six Sigma & the CMMI.

Reference Books

Title	Publisher	Year
Software Engineering –Ian Somerville	Pearson	2019
Software Engineering: A Practitioner's Approach–Roger Pressman	McGraw-Hill	2020
Agile Software Development–RobertC.Martin	Prentice Hall	2006
Clean Code–Robert C.Martin	Prentice Hall	2008


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25CA5208 - DATA STRUCTURES

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA5208	DATA STRUCTURES	DS	R	3	0	2	2	4.5

Course Outcomes

CO#	CO Description	BTL
CO1	Apply linear data structures for algorithmic problem solving.	3
CO2	Implement tree and graph structures for solving hierarchical and networked problems.	4
CO3	Analyze and apply searching and sorting algorithms for structured datasets.	4
CO4	Analyze and build optimized solutions using combined data structure techniques.	4
CO5	Implement and evaluate linear and non-linear data structures (such as arrays, linked lists, stacks, queues, trees, and graphs) using a programming language.	4
CO6	Develop and test real-time applications using appropriate data structures and algorithms to solve structured and unstructured problems.	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	C01	C02	C03	C04	C05	C06
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3			3	3	
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.						
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2		3		3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			2		3	

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PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.							2
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.							1

Syllabus

Module 1: Linear Data Structures Introduction to data structures: arrays, lists (singly, doubly), stacks, queues, circular queues. Operations: insertion, deletion, traversal. Applications in recursion, expression evaluation, job scheduling. Implementations using Python (lists, collections.deque).

Module 2: Non-Linear Data Structures Trees: binary trees, traversal techniques, BST, heaps. Graphs: adjacency list/matrix, BFS, DFS, applications in networking and social graphs. Emphasis on representation and traversal. Illustrations in Python using dictionaries and sets.

Module 3: Searching and Sorting Techniques: Linear and binary search. Sorting: bubble, selection, insertion, merge, quick, heap sort. Algorithm analysis: time complexity and space trade-offs. Performance comparisons using built-in and custom implementations.

Module 4: Advanced Topics & Case Studies: Hashing and hash tables, collision handling. Priority queues, disjoint sets, applications in compilers and resource management. Mini-project: implement a basic memory manager, scheduler, or recommendation engine using core data structures.

Reference Books:

Title	Publisher	Year
Data Structures and Algorithms in Python – Michael T. Goodrich	Wiley	2016
Fundamentals of Data Structures – Ellis Horowitz, Sartaj Sahni	Universities Press	2008
Problem Solving with Algorithms and Data Structures Using Python – Miller & Ranum	Franklin Beedle	2012
Algorithms, Part I & II – Robert Sedgewick, Kevin Wayne	Coursera/Princeton	2022
Data Structures and Algorithms Made Easy – Narasimha Karumanchi	CareerMonk	2016

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25CA5209 - DATABASE MANAGEMENT SYSTEMS

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA5209	DATABASE MANAGEMENT SYSTEMS	DBMS	R	3	0	2	0	4

Course Outcomes

CO#	C O Description	BTL
CO1	Design relational databases using ER modeling and normalization techniques.	3
CO2	Write efficient SQL queries and apply transaction handling concepts.	3
CO3	Explain the internal architecture of a DBMS and apply query execution principles.	3
CO4	Use NoSQL databases and integrate databases into software applications.	4
CO5	Evaluate various query processing methods and justify their effectiveness for optimizing database performance.	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	C1	C2	C3	C4	C5
PO1	Computational Knowledge: Acquire knowledge of advanced Programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.		3	3		
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.	3				3
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.	2			3	
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3		3	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical					2

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	responsibility.					
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.			2		

Syllabus

Module 1: Database Concepts and Design

Database characteristics and architecture. Data models: hierarchical, network, relational. ER diagrams, attributes, keys, cardinality, generalization/specialization. Relational schema design: translating ER to tables. Normalizations: 1NF, 2NF, 3NF, 5NF, BCNF

Module 2: SQL and Transaction Management

SQL: DDL, DML, DCL, TCL. Queries with 'SELECT', joins, subqueries, views, indexes, sequences. Aggregate functions, GROUP BY, HAVING, nested queries. Transactions: ACID properties, commit/rollback, concurrency control basics.

Module 3: Database Architecture and Storage

Database system architecture, storage structures, indexing (B-trees, hash), buffer management, file organization. Query processing and optimization basics. Role of DBMS in enterprise applications.

Module 4: NoSQL and Database Connectivity

Introduction to NoSQL: key-value, document, column, graph databases. MongoDB CRUD operations. Database connectivity using JDBC/Python connectors. Cloud databases: Firebase, Google BigQuery, AWS RDS overview.

Reference Books

Title	Publisher	Year
Database System Concepts – Silberschatz, Korth, Sudarshan	McGraw Hill	2020
Fundamentals of Database Systems – Elmasri & Navathe	Pearson	2021
SQL in 10 Minutes – Ben Forta	Sams Publishing	2019
Learning MongoDB – Doug Bierer	Packt	2020
Beginning Database Design – Clare Churcher	Apress	2016

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25CA6110 - DATA SCIENCE & BIG DATA ANALYTICS

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA6110	DATA SCIENCE & BIG DATA ANALYTICS	DS	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL
CO1	Perform data collection, cleaning, and exploration using Python tools.	3
CO2	Build visual analytics and dashboards to communicate data insights.	3
CO3	Use big data tools to process and analyze large-scale datasets.	4
CO4	Construct end-to-end data science workflows and deploy models.	4
CO5	Design and implement end-to-end ETL pipelines using Pandas and Scikit-learn, and deploy data models using RESTful APIs and cloud platforms	4

Program Outcomes & Program Specific Outcomes

PO/P SO	PO/PSO Description	C O1	C O2	C O3	C O4	C O5	C O6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3			3	3	
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.	2	3	3			
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.			2		3	
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.				2		
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.						
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements						

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while upholding professional ethics and societal responsibilities.

Syllabus

Module 1: Data science lifecycle and roles. Types of data: structured, unstructured, semi-structured. Data collection and wrangling: missing data, normalization, transformation. Descriptive statistics. Python libraries: Pandas, NumPy.

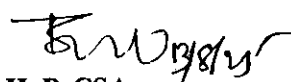
Module 2: Visualization types: line, bar, histogram, scatterplot, heatmap. Dashboards and storytelling using Matplotlib, Seaborn, Plotly. Overview of BI tools like Power BI and Tableau. Correlation and trend analysis.

Module 3: Big data fundamentals: 3Vs. Hadoop ecosystem: HDFS, MapReduce, YARN. NoSQL databases: MongoDB. Spark and PySpark: DataFrames, RDDs, transformations, actions. Structured Streaming basics.

Module 4: ETL pipelines using Pandas and Sklearn. Model serialization using Pickle/Joblib. RESTful APIs with Flask. Data pipelines: batch vs streaming. Cloud deployment basics using Google Colab, AWS, Azure (overview).

Reference Books

Title	Publisher	Year
Doing Data Science – Cathy O’Neil & Rachel Schutt	O’Reilly Media	2014
Python for Data Analysis – Wes McKinney	O’Reilly Media	2022
Big Data: Principles and Best Practices – Nathan Marz	Manning	2015
Data Science from Scratch – Joel Grus	O’Reilly Media	2023
Mastering Spark with Python – Andrew Morgan	Packt	2022


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25CA6111- DESIGN & ANALYSIS OF ALGORITHMS

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA6111	DESIGN & ANALYSIS OF ALGORITHMS	DAA	R	3	0	2	2	4.5

Course Outcomes

CO#	CO Description	BTL
CO1	Apply linear data structures for algorithmic problem solving.	3
CO2	Implement tree and graph structures for solving hierarchical and networked problems.	4
CO3	Analyze and apply searching and sorting algorithms for structured datasets.	4
CO4	Analyze and build optimized solutions using combined data structure techniques.	4
CO5	Develop and implement algorithms using modern programming tools to solve real-time problems in lab settings	4
CO6	Demonstrate problem-solving and debugging skills by applying algorithmic techniques in mini-projects or case studies	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3			3	3	
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.						
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2		3		3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			2		3	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal						2

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	skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.						
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.						1

Syllabus

Module 1: Algorithm Foundations and Complexity:

Concepts of algorithm, pseudo-code conventions, asymptotic notations (Big-O, Omega, Theta), best/average/worst case complexity. Recursion and recurrence relations. Time-space trade off. Introduction to complexity classes (P, NP).

Module 2: Algorithm Design Techniques - I:

Divide and conquer- merge sort, quick sort, binary search, matrix multiplication. Greedy algorithms: fractional knapsack, activity selection, Huffman coding. Implementation in Python or C/C++. Applications in real-world problems.

Module 3: Algorithm Design Techniques – II:

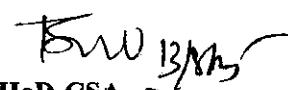
Dynamic programming: Fibonacci, matrix chain multiplication, 0/1 knapsack, LCS. Backtracking: N-Queens, subset sum. Complexity of dynamic and backtracking algorithms. Memorization. Tabulation.

Module 4: Graph Algorithms and Optimization:

Graph representation (adjacency list/matrix), BFS, DFS, shortest path (Dijkstra, Bellman-Ford), minimum spanning tree (Prim's, Kruskal's), topological sorting. Applications in networks and compilers.

Reference Books

Title	Publisher	Year
Introduction to Algorithms – Cormen, Leiserson, Rivest, Stein	MIT Press	2022
Algorithm Design – Jon Kleinberg & Éva Tardos	Pearson	2020
Data Structures and Algorithms in Python – Goodrich et al.	Wiley	2016
The Algorithm Design Manual – Steven Skiena	Springer	2020
Foundations of Algorithms – Richard Neapolitan	Jones & Bartlett Learning	2015


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25CA6112 - CLOUD DEVSECOPS

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA6112	CLOUD DEVSECOPS	CDSO	R	1	0	0	4	2

Course Outcomes

CO#	CO Description	BTL
CO1	Understand DevOps culture and cloud infrastructure automation techniques	3
CO2	Design and implement end-to-end CI/CD pipelines using DevOps tools.	4
CO3	Apply security practices across the DevOps lifecycle using automation tools.	4
CO4	Integrate observability tools and reliability engineering in cloud-native environments.	4
CO5	Analyze and apply cloud environments and cloud security governance practices.	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	2	3		2	3
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.					
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.	3	2	3		
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.				3	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.					3

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Syllabus

Module 1: DevOps Foundations and Cloud Infrastructure:

DevOps principles: collaboration, CI/CD, feedback loops. Infrastructure as Code (IaC) with Terraform and CloudFormation. Introduction to containers (Docker), orchestration (Kubernetes). Cloud platforms: AWS, Azure, GCP (vendor-neutral practices).

Module 2: CI/CD Pipeline Implementation:

CI tools: GitHub Actions, Jenkins pipelines. CD with Docker Compose and Kubernetes deployments. Version control workflows (Git flow). Release management. Artifacts and package registries. Deployment strategies: blue-green, canary.

Module 3: Security in DevOps (DevSecOps): Security by design. SAST, DAST. Secret management (Vault, AWS Secrets Manager). Secure image creation and vulnerability scanning. Compliance as Code. OWASP DevSecOps pipeline.

Module 4: Monitoring, Logging, and Observability: Monitoring tools: Prometheus, Grafana, CloudWatch. Log aggregation: ELK stack, Fluentd, Loki. Distributed tracing basics (Jaeger). Incident response and alerting. Site reliability engineering (SRE) principles.

Reference Books

Title	Publisher	Year
The DevOps Handbook – Gene Kim et al.	IT Revolution	2021
Learning DevOps – Mikael Krief	Packt	2021
Infrastructure as Code – Kief Morris	O'Reilly Media	2021
Kubernetes Up & Running – Hightower, Burns, Beda	O'Reilly Media	2022
Securing DevOps – Julien Vehent	Manning	2018

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25CA6113 - AI TOOLS FOR IT MANAGERS

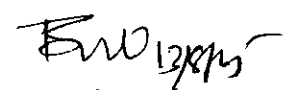
Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA6113	AI TOOLS FOR IT MANAGERS	AITM	R	0	0	4	0	2

Course Outcomes

CO#	CO Description	BTL
CO1	Identify suitable categories of Artificial Intelligence and strategic adoption areas in IT, and apply low-code AI tools to automate workflows and enhance business processes.	3
CO2	Design effective prompts and utilize Large Language Model (LLM) tools to automate routine IT workflows, while evaluating and managing ethical risks in AI adoption for IT systems.	3

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO 1	CO 2
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	2	
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.		2
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.	2	


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Syllabus

Module 1: AI vs ML vs DL. Types of AI:

Narrow, general, strong. Real-world AI use cases in HR, finance, operations, marketing. Benefits, risks, and limitations. Overview of AI adoption frameworks for business. Overview of low-code AI platforms: Microsoft Power Platform, Google Vertex AI, IBM Watson. Use of Zapier and Make for automation. Intro to RPA tools: UiPath, Automation Anywhere. Intelligent document processing tools.

Module 2: Prompt Engineering and LLM Tools Prompt design for productivity tools (ChatGPT, Bard, Claude). Types of prompts: zero-shot, few-shot, chain-of-thought, role-based. Building internal copilots for IT tasks. Automating documentation, report writing, ticket handling with AI tools. Ethical AI Use and AI Governance in IT- Ethical AI principles, AI bias and explainability. AI governance frameworks (ISO/IEC 42001, NIST AI RMF). Risk assessment matrices. Responsible AI dashboards (Google What-If Tool, AI Fairness 360).

Reference Books

Title	Publisher	Year
AI Superpowers – Kai-Fu Lee	Houghton Mifflin Harcourt	2018
Responsible AI – Virginia Dignum	Springer	2019
The Art of Prompt Engineering with ChatGPT – Nathan Hunter	Independently Published	2023
Artificial Intelligence for Managers – Thomas H. Davenport	Harvard Business Review Press	2020
AI Ethics – Mark Coeckelbergh	MIT Press	2020

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25CA52A1- MACHINE LEARNING

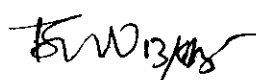
CourseCode	CourseTitle	Acronym	Mode	L	T	P	S	CR
25CA52A1	MACHINE LEARNING	ML	R	3	0	0	0	3

Course Outcomes

CO#	CODescription	BTL
CO1	Understand ML types, basic workflows, and the learning process.	2
CO2	Apply key supervised learning models using standard libraries.	3
CO3	Use unsupervised techniques for pattern discovery in datasets.	3
CO4	Tune and interpret ML models and prepare them for basic deployment.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.				
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.				
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		3		2
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		2	2	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				2
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.	1			


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Syllabus

Module 1: Fundamentals of Machine Learning

Overview of ML types: Supervised, unsupervised, reinforcement. Learning paradigms: classification, regression, clustering. Training vs testing. Bias-variance tradeoff. ML lifecycle. Use cases in industry.

Module 2: Supervised Learning Models

Supervised Learning Models Linear regression, logistic regression, decision trees, k-NN, Naive Bayes, model evaluation (accuracy, confusion matrix, precision, recall, F1-score). Use of scikit-learn for model training and evaluation.

Module 3: Unsupervised Learning & Dimensionality Reduction

Clustering: k-means, hierarchical clustering. Dimensionality reduction: PCA, t-SNE. Feature scaling, standardization. Practical applications in market segmentation, anomaly detection.

Module 4: Model Tuning and Interpretability

Cross-validation, grid search, hyperparameter tuning. Model serialization: Pickle, Joblib. Deployment fundamentals using lightweight APIs (Flask). Introduction to model interpretability (feature importance, SHAP basics).

Reference Books

Title	Publisher	Year
Hands-On Machine Learning with Scikit-Learn, Keras – Aurélien Geron	O'Reilly Media	2022
Introduction to Machine Learning with Python – Müller & Guido	O'Reilly Media	2016
Pattern Recognition and Machine Learning – Christopher Bishop	Springer	2007
Machine Learning – Tom M. Mitchell	McGraw Hill	2017
Machine Learning Engineering – Andriy Burkov	True Positive Inc.	2020

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25CA52C1-INTRODUCTION TO CYBER SECURITY & ETHICAL HACKING

CourseCode	CourseTitle	Acronym	Mode	L	T	P	S	CR
25CA52C1	INTRODUCTION TO CYBER SECURITY & ETHICAL HACKING	CSEH	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL
CO1	Understand threat models and basic risk principles.	2
CO2	Apply ethical reconnaissance and exploitation simulations.	3
CO3	Use scanning and enumeration tools to assess weak points.	4
CO4	Identify modern vectors in wireless and cloud platforms using simulation tools.	4

Program Outcomes & Program Specific Outcomes

PO/PS	PO/PS Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3			
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.	3	3		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2		3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			3	3
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.			2	

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Syllabus

Module 1: Foundations of Cybersecurity

Cybersecurity goals, principles (CIA triad), threat categories, cybersecurity attack surfaces, vulnerability vs exploit vs payload. Security policies, risk management basics. Current threat landscape.

Module 2: Ethical Hacking Fundamentals

Phases of ethical hacking (without PTVA depth): Foot printing, open-source intelligence (OSINT), email tracking, Google hacking, social engineering attacks, phishing kits, malware droppers.

Module 3: Network & Web Vulnerability

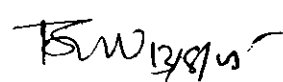
Mapping DNS interrogation, WHOIS and dig tools, Shodan, DNSdumpster. Web vulnerability scanners (Nikto, Vega, OWASP ZAP basics), session hijacking, cookie stealing, browser exploitation (BeEF overview).

Module 4: Cloud and Wireless Threat

Simulation Attacks in wireless networks: rogue APs, deauthentication. Cloud-specific threats: misconfigured buckets, IAM mismanagement, password spraying. Real-world toolkits: EvilTwin, Wifiphisher, Cloud Sploit

Reference Books

Title	Publisher	Year
Cybersecurity and Ethical Hacking Handbook – Ahmed Refaey Hussein	Packt	2022
The Hacker Playbook 3 – Peter Kim	Red Team Field Manual	2020
Social Engineering – Chris Hadnagy	Wiley	2021
Practical IoT Hacking – Fotios Chantzis	No Starch Press	2021
Kali Linux Revealed – Raphael Hertzog	Offensive Security	2022


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25CA61A2-DEEP LEARNING

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA61A2	DEEP LEARNING	DL	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL
CO1	Explain and implement basic neural networks with appropriate activation and loss functions.	3
CO2	Train and optimize deep neural networks using modern frameworks.	4
CO3	Apply CNNs and RNNs for vision and sequence-related problems.	4
CO4	Deploy deep learning models and apply them to enterprise IT usecases.	4
CO5	Analyze and compare CNNs, RNNs, autoencoders, GANs to select the best model for applications.	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	C	O	1	2	3	4	5	6
PO1	Computational Knowledge: Acquire knowledge of computing skills, and domain knowledge for developing applications for problems.			3		3			
PO2	Design and Development: Design and develop efficient solutions for complex problems across different domains		3					3	
PO3	Research: Apply research-based knowledge and methodologies to analyze, design and interpret data using the right tools, to provide conclusions.		2				3		
PO4	Continuous learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.			3			3		
PO5	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.								2
PO6	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems that cannot be solved						2		

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by straightforward application of knowledge, theories and techniques applicable to the engineering discipline.

Syllabus

Module 1: Introduction to Deep Learning & Neural Networks

Limitations of traditional ML. Introduction to neural networks: perceptron, activation functions (ReLU, sigmoid, tanh), loss functions. Feedforward NN architecture. Gradient descent and backpropagation.

Module 2: Training Deep Neural Networks

Overfitting/underfitting, regularization (dropout, L2), optimization algorithms (SGD, Adam, RMSprop), batch normalization. Hyperparameter tuning, initialization strategies. TensorFlow and PyTorch basics.

Module 3: Convolutional and Recurrent Neural Networks CNN architecture: convolution layers, pooling, flattening, applications in image processing. RNNs: sequence modeling, vanishing gradient, LSTM, GRU, use cases in NLP and time series. Model evaluation metrics.

Module 4: Industry Applications and Model Deployment Transfer learning, fine-tuning pre-trained models (VGG, ResNet, BERT overview). ONNX export, model quantization, TFLite. Deployment via Flask/FastAPI. Use cases in document classification, chatbot NLP, fraud detection.

Reference Books

Title	Publisher	Year
Neural Networks and Deep Learning	Springer	2022
Generative Deep Learning: Teaching Machines to Paint, Write, Compose	O'Reilly Media	2021
Natural Language Processing with Transformers	O'Reilly Media	2021
Deep Reinforcement Learning Hands-On	Packt Publishing	2020

BW

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25CA61A3-NATURAL LANGUAGE PROCESSING & LARGE LANGUAGE MODELS

CourseCode	CourseTitle	Acronym	Mode	L	T	P	S	CR
25CA61A3	NATURAL LANGUAGE PROCESSING & LARGE LANGUAGE MODELS	NLP	R	3	0	0	0	3

Course Outcomes

CO#	CODescription	BTL
CO1	Preprocess and structure textual data using foundational NLP techniques.	3
CO2	Build classical NLP models using word embeddings and supervised learning.	4
CO3	Apply transformer-based LLMs for diverse NLP tasks using pre-trained models.	4
CO4	Build enterprise NLP applications using LLMs with awareness of ethical concerns.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.			3	
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.				3
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.	2	3	3	
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3		3
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				

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PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.				
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Syllabus

Module 1: Foundations of NLP and Text Processing

NLP pipeline: Text preprocessing (tokenization, stemming, lemmatization), POS tagging, named entity recognition (NER). Stopword removal, word frequency analysis, BoW and TF-IDF representations. Tools: NLTK, spaCy.

Module 2: Vectorization and Classical Models

Word embeddings: Word2Vec, GloVe, FastText. Text classification with Naive Bayes, logistic regression, SVM. Applications in sentiment analysis, spam detection, topic modeling. Sklearn pipeline integration.

Module 3: Large Language Models and Transformers

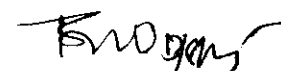
Attention mechanism, Transformer architecture. Pre-trained models: BERT, RoBERTa, DistilBERT. Hugging Face Transformers API for classification, question answering. Fine-tuning and transfer learning.

Module 4: Industry Applications & Responsible Use

Chatbots, virtual assistants, document summarization, content moderation, resume screening. Building custom Q&A systems using RAG. Prompt engineering basics. Responsible AI, hallucination handling, bias mitigation.

Reference Books

Title	Publisher	Year
Speech and Language Processing – Jurafsky & Martin	Pearson	2023
Natural Language Processing with Python – Bird, Klein, Loper	O'Reilly Media	2019
Transformers for Natural Language Processing – Denis Rothman	Packt	2021
Practical Natural Language Processing – Sowmya Vajjala et al.	O'Reilly Media	2020


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25CA61C2-PENETRATION TESTING & VULNERABILITY ASSESSMENT

CourseCode	CourseTitle	Acronym	Mode	L	T	P	S	CR
25CA61C2	PENETRATION TESTING & VULNERABILITY ASSESSMENT	PTVA	R	3	0	2	0	4

Course Outcomes

CO#	CODescription	BTL
CO1	Conduct reconnaissance and vulnerability scanning using standard tools.	3
CO2	Simulate system/network exploits and identify privilege escalation paths.	4
CO3	Exploit and mitigate web app vulnerabilities using industry tools.	4
CO4	Document security assessments and recommend appropriate remediations.	4
CO5	Implement end-to-end penetration testing using lifecycle, reconnaissance and exploitation techniques.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.			3	2	3
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.					
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2			
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3	3		3
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				2	
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while					

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upholding professional ethics and societal responsibilities.

Syllabus

Module 1: Foundations of Ethical Hacking & Vulnerability Assessment

Penetration testing lifecycle and rules of engagement. Footprinting and reconnaissance. Vulnerability types: misconfiguration, insecure APIs, unpatched systems. Vulnerability scanning: Nessus, OpenVAS, Nikto. CVE and CVSS standards.

Module 2: System and Network Exploitation

Network-based attacks: ARP spoofing, DNS poisoning, sniffing, replay attacks. Exploiting system vulnerabilities using Metasploit, msfvenom. Privilege escalation techniques. Wireless hacking basics (Aircrack-ng).

Module 3: Web Application and Password Attacks

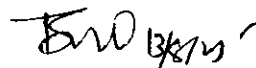
OWASP Top 10 vulnerabilities: SQLi, XSS, CSRF, IDOR. Attacking login mechanisms, brute force, credential stuffing. Tools: Burp Suite, Hydra, Hashcat. Session hijacking and cookie manipulation.

Module 4: Reporting and Defense Recommendations

Creating vulnerability and pentest reports. Prioritizing risks. Mitigation strategies. Post-exploitation steps. Legal and ethical responsibilities. Mapping findings to security frameworks (NIST, ISO 27001).

Reference Books

Title	Publisher	Year
CompTIA PenTest+ Certification Guide – Crystal Panek	Packt	2022
The Web Application Hacker's Handbook – Stuttard & Pinto	Wiley	2011
Kali Linux Revealed – Raphael Hertzog	Offensive Security	2022
Metasploit: The Penetration Tester's Guide – David Kennedy	No Starch Press	2018
The Hacker Playbook 3 – Peter Kim	Red Team Field Manual	2020


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25CA61C3-SECURE SOFTWARE ENGINEERING

CourseCode	CourseTitle	Acronym	Mode	L	T	P	S	CR
25CA61C3	SECURE SOFTWARE ENGINEERING	DC	R	3	0	0	0	3

Course Outcomes

CO#	CODescription	BTL
CO1	Understand the integration of security throughout the software development lifecycle.	3
CO2	Apply secure coding techniques to prevent common software vulnerabilities.	4
CO3	Perform secure software testing using static and dynamic analysis tools.	4
CO4	Design secure systems and ensure compliance with security standards.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	2	3		
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.		3		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2	3	
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3		2
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				2
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.	2			

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Syllabus

Module 1: Secure Software Development Lifecycle (SSDLC)

Need for secure software. Introduction to SSDLC models. Threat modelling (STRIDE), risk assessment. Secure requirements and design. OWASP SAMM and BSIMM maturity models.

Module 2: Secure Coding Practices

Common coding vulnerabilities: buffer overflows, injection attacks, XSS, CSRF, insecure deserialization. Input validation, output encoding, and secure session management. Language-specific secure coding (Java, Python, C++).

Module 3: Static and Dynamic Analysis Tools

Security testing techniques: static analysis (SAST), dynamic analysis (DAST). Tools: SonarQube, Fortify, OWASP ZAP, Burp Suite. Secure code reviews. Security test automation basics. DevSecOps overview.

Module 4: Security Design Patterns and Compliance

Security design patterns: secure architecture, fail-safe defaults, defense-in-depth. Secure API design. Secure deployment practices. Compliance standards: ISO/IEC 27001, NIST, GDPR. Secure logging and auditing.

Reference Books

Title	Publisher	Year
Software Security: Building Security In-Gary McGraw	Addison-Wesley	2020
Security Engineering-Ross Anderson	Wiley	2021
The Web Application Hacker's Handbook-Stuttard & Pinto	Wiley	2011
OWASP Testing Guide v4-OWASP Foundation	OWASP	2021
Dev SecOps- Jim Bird	O'Reilly Media	2023

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25CA62A4-GENERATIVE AI

CourseCode	CourseTitle	Acronym	Mode	L	T	P	S	CR
25CA62A4	GENERATIVE AI	GNAI	R	3	0	2	0	4

Course Outcomes

CO#	CODescription	BTL
CO1	Understand the mathematical and conceptual foundations of generative models.	2
CO2	Design and train GAN-based architectures for image and content generation.	4
CO3	Implement LLMs for natural language generation tasks using modern frameworks.	4
CO4	Build business-relevant generative AI applications while addressing ethical constraints.	4
CO5	Develop and evaluate generative AI applications using the Python programming language.	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	2				3
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.			3		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		2			
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			2	3	3
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				2	

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PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.						
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Syllabus

Module 1: Foundations of Generative AI

Overview of generative modeling. Types: GANs, VAEs, autoregressive models, diffusion models. Comparison with discriminative models. Applications in content creation, simulation, and automation.

Module 2: Generative Adversarial Networks (GANs)

GAN architecture: Generator, discriminator, loss functions. DCGAN, CycleGAN, StyleGAN. Common challenges: mode collapse, instability. GAN applications in image synthesis, data augmentation, deepfakes.

Module 3: Text Generation and LLMs

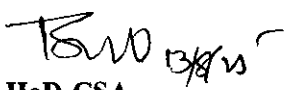
Auto-regressive models (GPT), masked models (BERT), transformers. Tokenization, fine-tuning, LoRA. Hugging Face Transformers for text generation. Applications in text completion, summarization, translation.

Module 4: Enterprise Use Cases and Ethical Considerations

Enterprise applications: Synthetic data generation, marketing content, code generation. Introduction to RAG and retrieval-based generation. Responsible AI: hallucinations, bias, transparency, content filtering.

Reference Books

Title	Publisher	Year
Deep Learning with Python – François Chollet	Manning	2021
Generative Deep Learning – David Foster	O'Reilly Media	2022
GANs in Action – Jakub Langr & Vladimir Bok	Manning	2020
Transformers for Natural Language Processing – Denis Rothman	Packt	2021
Practical Generative AI – Krishna Gaihre	BPB Publications	2023


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25CA62C4-DIGITAL & CYBER FORENSICS

CourseCode	CourseTitle	Acronym	Mode	L	T	P	S	CR
25CA62C4	DIGITAL & CYBER FORENSICS	DC	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL
CO1	Understand the fundamentals of digital forensics and the legal framework of cybercrime.	2
CO2	Perform analysis of file systems and operating system artifacts using forensic tools.	3
CO3	Analyze digital evidence from network traffic and mobile devices.	4
CO4	Handle cyber incidents and document forensic findings according to professional standards.	4
CO5	Implement and evaluate forensic investigation procedures through hands-on simulations, ensuring proper documentation, chain of custody, and response to security incidents.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.		2			
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.			3		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.			2	3	
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3		2	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				2	3

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PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.	2				3
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Syllabus

Module 1: Introduction to Digital Forensics

Definition, scope, and objectives of digital forensics. Digital crime categories and cybercrime ecosystem. Legal framework and admissibility of digital evidence. Forensics process: identification, acquisition, preservation, analysis, documentation, presentation.

Module 2: File System and Operating System Forensics

File systems: FAT, NTFS, ext3/ext4. Data hiding techniques: steganography, slack space. OS-level forensics: Windows registry, log files, volatile memory analysis. Imaging tools: FTK Imager, Autopsy, EnCase overview.

Module 3: Network and Mobile Forensics

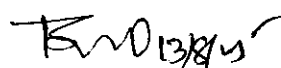
Packet analysis with Wireshark. Email headers, spoofing, phishing analysis. Mobile OS forensics: Android, iOS architecture. SIM and SD card forensics. Tools: Cellebrite, Oxygen Forensics, Volatility framework.

Module 4: Incident Response and Reporting

Incident response lifecycle: preparation, detection, containment, eradication, recovery. Chain of custody, documentation standards. Case study investigations. Digital forensics lab setup and hands-on simulation.

Reference Books:

Title	Publisher	Year
Guide to Computer Forensics and Investigations – Nelson, Phillips, Enfinger	Cengage	2020
Digital Forensics and Cyber Crime – Joshua I. James	Springer	2021
Incident Response & Computer Forensics – Jason Luttgens	McGraw Hill	2014
Mobile Forensics – RohitTamma	Packt	2022
The Art of Memory Forensics – Case, Richard, Walters	Wiley	2014


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25CA62C5-MALWARE ANALYSIS

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25CA62C5	MALWARE ANALYSIS	MA	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL
CO1	Identify different types of malware and describe their roles and effects within the cybersecurity landscape.	2
CO2	Apply static analysis techniques to extract actionable intelligence from malware binaries.	3
CO3	Analyze the behavior of malware through runtime execution and interactions with system components.	4
CO4	Analyze malware using reverse engineering and develop defensive signatures and detection rules.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3			
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.	3			
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.		3	3	3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.			3	2
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				

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PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.				3
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Syllabus

Module 1: Introduction to Malware and Threat Landscape

Types of malware: viruses, worms, trojans, ransomware, spyware, rootkits. Malware attack vectors. Static vs dynamic analysis. Malware lifecycle and objectives. Overview of threat intelligence feeds and sandboxing.

Module 2: Static Malware Analysis

Analyzing PE and ELF files. Tools: PEiD, Exeinfo PE, BinText, Dependency Walker. Disassembling using Ghidra, IDA Free. String analysis, header inspection, and hash identification. Antivirus evasion techniques.

Module 3: Dynamic Malware Analysis

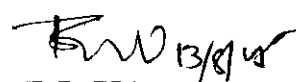
Setting up isolated lab environments. Tools: Process Monitor, Process Explorer, Wireshark, Regshot. Monitoring file, process, registry, and network activities. API hooking, behavior-based detection.

Module 4: Reverse Engineering and Defensive Strategies

Debugging with x64dbg, OllyDbg. Control flow graph analysis. Anti-debugging and obfuscation techniques. YARA rules and Snort signatures. Malware classification and memory forensics (Volatility)..

Reference Books

Title	Publisher	Year
Practical Malware Analysis – Michael Sikorski & Andrew Honig	No Starch Press	2012
Malware Analyst's Cookbook – Ligh, Adair, Hartstein, Richard	Wiley	2010
The Art of Memory Forensics – Case, Richard, Walters	Wiley	2014
Learning Malware Analysis – Monnappa K A	Packt	2018
Practical Reverse Engineering – Bruce Dang et al.	Wiley	2014


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25SDMC01 - FRONT END DEVELOPMENT FRAMEWORKS

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25SDMC01	FRONT END DEVELOPMENT FRAMEWORKS	FEDF	R	1	0	0	4	2

Course Outcomes

CO#	CO Description	BTL
CO1	Design static and responsive web interfaces using HTML, CSS, and JavaScript.	3
CO2	Develop dynamic web interactions using JavaScript and DOM programming.	3
CO3	Build interactive UI components using React framework.	4
CO4	Implement routing, styling, and state handling for frontend web apps.	4
CO5	Design Dynamic Web Pages by using HTML, CSS, JS, PHP	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO 1	CO 2	CO 3	CO 4	CO 5
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3				
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.			3	3	
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.	2	2	3	3	3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.					3
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver					

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	solutions and operational procedures with ethical responsibility.					
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.	1				

Syllabus

Module 1 HTML5 structure and semantic tags, CSS3 styling, media queries for responsive design. JavaScript basics: syntax, DOM manipulation, event handling. Modern frontend development principles (SPA, modular design, mobile-first development)..

Module 2 JavaScript ES6+ features: let/const, arrow functions, destructuring, spread/rest operators. DOM selection and manipulation, events, forms, validation. Debugging in browser dev tools.

Module 3: Introduction to React: components, props, state, JSX syntax, event handling in React. Lifecycle methods, functional vs class components, hooks (useState, useEffect). Component-based architecture for scalable UI.

Module 4: Routing with React Router, dynamic routes. Styling: CSS Modules, Styled Components, Material UI. State management: lifting state, context API. Deployment using Vite, Netlify or GitHub Pages. Accessibility and SEO basics.

Reference Books:

Title	Publisher	Year
HTML & CSS: Design and Build Websites by Jon Duckett	Wiley	2011
JavaScript: The Good Parts by Douglas Crockford	O'Reilly Media	2008
Learning React by Alex Banks and Eve Porcello	O'Reilly Media	2020
CSS Secrets by Lea Verou	O'Reilly Media	2015
Fullstack React by Anthony Accomazzo et al.	Fullstack.io	2017

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25SDMC02- FULL STACK APPLICATION DEVELOPMENT

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25SDMC02	FULL STACK APPLICATION DEVELOPMENT	FSAD	R	1	0	0	4	4.5

Course Outcomes

CO#	CO Description	BTL
CO1	Apply web development fundamentals using HTML, CSS, JavaScript, and ReactJS to build interactive user interfaces.	3
CO2	Implement advanced React concepts including routing, state management, and performance optimizations for enterprise applications.	4
CO3	Develop backend applications using Spring Boot, REST APIs, and database interactions for dynamic full stack systems.	4
CO4	Apply security principles such as authentication, authorization, and role-based access control in web applications.	4
CO5	Integrate Spring Cloud and deploy scalable, secure full stack applications with performance monitoring capabilities.	4
CO6	Design and build real-time full stack applications by integrating frontend and backend technologies to solve real-world problems.	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3	3	3	3	3	3
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.	3	3	3	3	3	3
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.	3	3	3	3	3	3
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.	3	3	3	3	3	3
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational	3	3	3	3	3	2

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	procedures with ethical responsibility.						
PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.						2

Syllabus

Module 1: Introduction to HTML, CSS, and JavaScript for web development. ReactJS concepts: functional components, JSX, props, component communication. Hooks: useState, useEffect, useContext, useReducer. Creation and usage of custom hooks and error boundaries. State management techniques: local and global state, prop drilling. Redux fundamentals: actions, reducers, store. UI styling and responsiveness using Tailwind CSS or Bootstrap.

Module 2: Core Node.js concepts: event-driven architecture, asynchronous programming. Express.js framework: routing, middleware, REST API development. Request-response lifecycle, input validation. MongoDB integration via Mongoose for schema modeling and queries. Implement JWT-based authentication and secure user sessions. Managing secure configurations with environment variables. Error handling mechanisms in backend services.

Module 3: Introduction to Spring Boot: setup, project structure, and configuration. Dependency injection and annotations. Building RESTful APIs with Spring Boot. Spring Data JPA with Hibernate for database interaction using MySQL/PostgreSQL. Implementation of CRUD operations. Error and exception handling. Application logging and unit testing using JUnit. Introduction to Swagger for API documentation.

Module 4: Principles of microservices architecture: decentralized systems, service decomposition. Inter-service communication using REST and gRPC. Service discovery mechanisms and use of API gateways. Deployment using Docker: containers, images, and Dockerfiles. CI/CD practices for automating build and deployment. Overview of Kubernetes concepts for orchestration. Introduction to Spring Cloud for service configuration and resilience.

Reference Books:

Title	Publisher	Year
Fullstack React – Accomazzo et al.	Fullstack.io	2021
Learning Node.js Development – Andrew Mead	Packt	2023
Spring Boot in Action – Craig Walls	Manning	2016
Microservices Patterns – Chris Richardson	Manning	2018
Building Microservices – Sam Newman	O'Reilly Media	2021

BSW 12/15
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25SDMC03 – WEB 3 DEVELOPMENT USING BLOCKCHAIN

CourseCode	CourseTitle	Acronym	Mode	L	T	P	S	CR
25SDMC03	WEB 3 DEVELOPMENT USING BLOCKCHAIN	WEB3	R	1	0	0	4	4.5

Course Outcomes

CO#	CO Description	BTL
CO1	Understand the principles of blockchain, decentralization, and Web3 ecosystems.	2
CO2	Write, test, and deploy smart contracts securely using Solidity.	3
CO3	Develop and integrate full-stack decentralized applications (dApps) using Web3 tools.	4
CO4	Apply secure smart contract practices and utilize core ecosystem tools for blockchain integration.	4
CO5	Analyze real-world blockchain-based applications including NFTs, DeFi, and DAO implementations.	4
CO6	Build scalable Web3 solutions incorporating decentralized storage, oracles, and cross-chain interoperability.	5

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4	CO5	CO6
PO1	Computational Knowledge: Gain knowledge of blockchain, distributed systems, and decentralized apps for solving real-world tech challenges.	3	3				
PO2	Problem Analysis: Identify, analyze, and design blockchain-based solutions by applying smart contract logic and consensus principles.	2	2		3		
PO3	Design and Development: Develop efficient and secure Web3 apps adhering to ethical standards and decentralized governance principles.			3		3	2
PO4	Modern Tool Usage: Apply blockchain IDEs, wallets, smart contract security tools, and Web3 frameworks for efficient development.				3		3
PO5	Project Management & Communication: Demonstrate project development and communication practices through DAO collaboration						2

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	and peer review.						
PO6	Lifelong Learning and Ethics: Acknowledge the societal, legal, and ethical aspects of decentralized systems and embrace continuous learning in Web3 tech.				2		1

Syllabus

Module 1: Foundations of Blockchain and Web3

Introduction to blockchain technology and distributed ledger systems.

Consensus mechanisms: Proof of Work (PoW), Proof of Stake (PoS), Practical Byzantine Fault Tolerance (PBFT).

Web3 concepts: self-sovereign identity, decentralized autonomous organizations (DAOs), and the contrast between centralization and decentralization. Overview of the Ethereum ecosystem and smart contracts.

Module 2: Smart Contract Development

Solidity programming: syntax, data types, functions, control structures, modifiers, and inheritance.

Smart contract lifecycle: deployment, execution, and termination. ERC standards: ERC-20 (fungible tokens) and ERC-721 (non-fungible tokens). Debugging and testing smart contracts using Remix IDE and Hardhat.

Module 3: Decentralized Application (dApp) Development

dApp architecture: frontend, smart contract, wallet integration. Connecting Web3 frontend using Web3.js and Ethers.js. Wallets: MetaMask, WalletConnect for user authentication and signing. Storing decentralized data using IPFS (InterPlanetary File System). Deploying dApps to testnets and mainnets.

Module 4: Web3 Security and Ecosystem Tools

Common security vulnerabilities: reentrancy, integer overflow/underflow, denial-of-service. Auditing tools: MythX, Slither, and static analysis. Web3 ecosystem tools: Chainlink oracles, The Graph for querying blockchain data, and Polygon for scaling. Cross-chain interoperability fundamentals. Introduction to DeFi, NFTs, DAOs, and regulatory perspectives.

Reference Books

Title	Publisher	Year
Mastering Ethereum – Andreas M. Antonopoulos	O'Reilly Media	2019
Introducing Ethereum and Solidity – Chris Dannen	Apress	2017
Blockchain Applications – Bahga&Madiseti	VPT	2021
Web3 Development Essentials – Tomasz Kajetan Stańczak	Packt	2023
Building Blockchain Apps – Michael Juntao Yuan	Addison-Wesley	2020

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25IE5201-ESSENTIALS OF RESEARCH DESIGN

Course Code	Course Title	Acronym	Mode	L	T	P	S	CR
25IE5201	ESSENTIALS OF RESEARCH DESIGN	ERD	R	1	1	0	0	2

Course Outcomes

CO#	CO Description	BTL
CO1	Understand the purpose and characteristics of various types of research in computer science	2
CO2	Formulate research problems and conduct literature reviews using academic tools.	3
CO3	Design appropriate methodologies for computing- related research.	4
CO4	Analyze research data and write structured reports in academic formats.	4

Program Outcomes & Program Specific Outcomes

PO/PSO	PO/PSO Description	CO1	CO2	CO3	CO4
PO1	Computational Knowledge: Acquire knowledge of advanced programming practices, computing skills, and domain knowledge for developing application software to solve real-world problems.	3			2
PO2	Problem Analysis: Ability to identify computing problems and analyze the components of a problem using principles of mathematics, specialized computing, and application strategies.		3		
PO3	Design and Development: Design and develop efficient solutions for complex problems across different domains while adhering to ethical and professional standards.			3	
PO4	Modern Tool Usage: Create, select, adapt, and apply appropriate techniques, resources, and modern IT tools to solve complex computing problems.		3	2	
PO5	Project Management and Communication: Demonstrate knowledge of project management principles, interpersonal skills, and effective communication within a team to deliver solutions and operational procedures with ethical responsibility.				3

BW 13/11/25

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PO6	Lifelong Learning and Ethics: Recognize the importance of lifelong learning in adapting to technological advancements while upholding professional ethics and societal responsibilities.	1			
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Syllabus

Module 1: Foundations of Research

Definition and objectives of research. Characteristics of good research. Types of research: basic, applied, exploratory, descriptive, analytical. Research ethics and plagiarism. Role of Research in computing disciplines.

Module2: Problem Formulation and Literature Review

Identifying and defining research problems. Research questions and hypotheses. Sources of literature. Literature review methods: narrative, systematic, and meta-analysis. Tools for Literature management (Zotero, Mendeley, Google Scholar).

Module3: Research Design and Methodology

Concepts of research design. Qualitative, quantitative, and mixed methods. Sampling techniques, data collection tools (questionnaires, interview, observation), validation of tools. Experiment Alveston-experimental research, Diagrammatic & Graphical Representation of data.

Module 4: Data Analysis and Research Reporting

Basics of statistical tools (SPSS, Excel). Data analysis: central tendency, dispersion, correlation, hypothesis testing (t-test, chi-square, ANOVA). Writing research papers: structure, abstract, introduction, results, conclusions. Referencing styles. Design Thinking and Innovation for Problem Solving.

Reference Books

Title	Publisher	Year
Research Methodology–C.R.Kothari & Gaurav Garg	New Age International	2021
Business Research Methods–Donald R.Cooper & Pamela Schindler	Mc Graw Hill	2022
Practical Research: Planning and Design–Paul D.Leedy, Jeanne Ellis Ormrod	Pearson	2019
The Craft of Research–Wayn C. Booth etal.	University of Chicago Press	2016
Writing for Computer Science–Justin Zobel	Springer	2014

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ANNEXURE III

Pre-PhD Subjects List LTPS:4-0-0-0

S.NO	PAPER1	SUBJECT CODE
1	Research Methodology	25RES101

S.NO	PAPER2	SUBJECT CODE	PAPER3	SUBJECT CODE
1	SOFTWARE DEVELOPMENT AND QUALITY ASSURANCE	25CSA101	HADOOP AND BIG DATA	25CSA201
2	NETWORK SYSTEMS AND PROTOCOLS	25CSA102	APPLIED ARTIFICIAL INTELLIGENCE	25CSA202
3	DATABASE MANAGEMENT SYSTEMS	25CSA103	DATA ANALYTICS	25CSA203
4	OPERATING SYSTEMS	25CSA104	APPLIED MACHINE LEARNING	25CSA204
5	OBJECT ORIENTED PROGRAMMING	25CSA105	PROBLEM SOLVING USING PYTHON PROGRAMMING	25CSA205
6	DATA STRUCTURES	25CSA106	SECURING WEB SYSTEMS AND NETWORKS	25CSA206
7	DESIGN AND ANALYSIS OF ALGORITHMS	25CSA107	DISTRIBUTED DATABASES	25CSA207
8	IOT DEVELOPMENT AND CONNECTIVITY	25CSA108	THE JOY OF COMPUTING USING R PROGRAMMING	25CSA208
9	SOFT COMPUTING TECHNIQUES AND APPLICATIONS	25CSA109	APPLIED DEEP LEARNING	25CSA209

B. V. S. R.
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10	ADVANCES IN COMPUTING	25CSA110	CLOUD INFRASTRUCTURE WITH SERVICES	25CSA210
11	MOBILE COMPUTING USING CLOUD	25CSA111	SERVICE MANAGEMENT IN CLOUD COMPUTING	25CSA211
12	DATA WAREHOUSING AND DATA MINING	25CSA112	DATA MANAGEMENT IN CLOUD COMPUTING	25CSA212
13	PRINCIPLES OF SOFTWARE RELIABILITY	25CSA113	SECURING CLOUD COMPUTING ENVIRONMENTS	25CSA213

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25 RES 101:RESEARCH METHODOLOGY

[COMMON TO ALL NON-ENGINEERING STREAMS]

UNIT I – Introduction to Research

This unit introduces the fundamental concepts of research, including its definition, objectives, and scope. It covers various types of research such as qualitative, quantitative, mixed methods, experimental, case study, comparative, longitudinal, and cross-sectional approaches. The steps in the research process are explained, along with strategies for identifying and defining a research problem. Emphasis is placed on conducting an effective literature review by using subject-specific databases such as Scopus, Web of Science, PubMed, JSTOR, AGRICOLA, and HeinOnline. The unit also addresses research ethics, including plagiarism, authorship, data integrity, and adherence to professional codes of conduct such as APA, MLA, ICMJE, and discipline-specific ethical guidelines.

UNIT II – Quantitative and Qualitative Methods

This unit focuses on both quantitative and qualitative research methods. Quantitative methods include statistical modeling, probability distributions, sampling techniques, hypothesis testing, regression, ANOVA, correlation, and multivariate analysis. Qualitative methods include interviews, focus groups, case studies, ethnographic research, and content or discourse analysis. The mixed-methods approach, which combines both quantitative and qualitative strategies, is also discussed. Concepts of error analysis, data reliability, and validity are introduced, along with examples of how these methods are applied across disciplines such as the sciences, social sciences, humanities, law, management, and other non-engineering fields.

UNIT III – Data Collection, Presentation, and Analysis

This unit examines the collection, organization, and presentation of research data. It discusses primary and secondary sources of data and outlines various tools and techniques for data collection, including surveys, experiments, observations, and archival research. Methods for presenting data in tabular and graphical form are explained, including tables, charts, histograms, scatter plots, and thematic maps. The unit also covers the preparation of datasets for analysis and the interpretation of research results. Software tools such as Excel, SPSS, R, NVivo, Atlas.ti, and other discipline-specific platforms are introduced to enhance data analysis capabilities.

UNIT IV – Digital Tools and Soft Computing in Research

This unit explores the role of computers and digital tools in modern research. It covers statistical analysis software such as SPSS, R, GRETL, MATLAB, STATA, and NVivo, as

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well as reference management tools like Mendeley, Zotero, and EndNote. An introduction to artificial intelligence and machine learning applications in research is provided, including text mining, image analysis, and predictive modeling. The unit also gives an overview of evolutionary algorithms, fuzzy logic, and neural networks, with emphasis on their applicability in non-engineering disciplines. The use of GIS, remote sensing, and other domain-specific tools is also addressed where relevant.

UNIT V – Research Communication and Report Writing

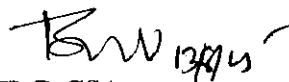
This unit focuses on the effective communication of research findings. It explains the structure and components of a research report, dissertation, or thesis, and describes the various types of research reports, including empirical, theoretical, review, case study, and policy documents. Guidelines for formatting according to styles such as APA, MLA, Chicago, IEEE, and OSCOLA are provided, depending on disciplinary requirements. The unit also covers writing abstracts, literature reviews, methodology, results, and discussions, as well as citation ethics and plagiarism avoidance. Finally, it discusses preparing papers for conferences and journals, and delivering research presentations through posters, PowerPoint slides, and online dissemination platforms.

Text Books

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, 2/e, Vishwa Prakashan, 2006
2. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners*, 4th Edition, SAGE Publications, 2014

Reference Books

1. John W. Creswell & J. David Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th Edition, SAGE Publications
2. Alan Bryman, *Social Research Methods*, 5th Edition, Oxford University Press
3. Uwe Flick, *An Introduction to Qualitative Research*, 6th Edition, SAGE Publications
4. Donald H. McBurney, *Research Methods*, 5th Edition, Thomson Learning


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25CSA101: SOFTWARE DEVELOPMENT AND QUALITY ASSURANCE

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

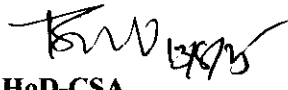
Introduction to Software Testing, Basics of Testing, Testing Principles, Objectives and Goals of Testing, Software Testing Life Cycle (STLC), V-Model and Shift-Left Testing, Levels of Testing – Unit, Integration, System, and Acceptance Testing, Types of Defects, Defect Classification, Defect Life Cycle, Defect Tracking and Reporting (e.g., JIRA), IEEE 829 Standard for Test Documentation. Black Box Testing Techniques – Concept, Need, and Scope, Test Case Design Techniques: Requirement-based Testing, Equivalence Partitioning, Boundary Value Analysis, Cause-Effect Graphing, State Transition Testing, Use Case-Based Testing, and Error Guessing. White Box Testing Techniques – Code Coverage (Statement, Branch, Path), Static Code Analysis, Basis Path Testing, Loop Testing, and Data Flow Testing. Testing Object-Oriented Systems – Class Testing, Integration of Classes, Testing Challenges with Inheritance and Polymorphism. Test Planning and Management – Test Strategy, Test Estimation, Risk-Based Testing, and Test Metrics (Project, Progress, and Productivity). Specialized Testing Types – GUI Testing, Usability Testing, Security Testing, Performance Testing, Mobile Application Testing, API Testing (Postman, SoapUI), Regression and Retesting, Smoke and Sanity Testing. Software Quality – Attributes (Reliability, Maintainability, Portability), Quality Assurance vs. Quality Control, Cost of Quality (Prevention, Appraisal, Failure), and Role of Testing in Agile and DevOps Environments.

Textbooks:

1. Foundations of Software Testing: ISTQB Certification, 4th Edition, By Rex Black, Dorothy Graham, Erik van Veenendaal, Pearson Education, ISBN: 978-9353439896
2. Software Testing: A Craftsman's Approach, 5th Edition, By Paul C. Jorgensen
CRC Press, ISBN: 978-1138591700.

NPTEL Courses:

1. Software Testing, By Prof. Rajib Mall, IIT Kharagpur, <https://nptel.ac.in/courses/106105150>
2. Software Testing, By Prof. Meenakshi D'Souza, IIIT Bangalore.
<https://nptel.ac.in/courses/106101163>


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25CSA102: NETWORK SYSTEMS AND PROTOCOLS

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

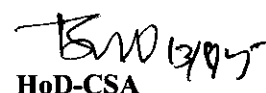
Introduction :- Networks, Network Types, Network Models :-The Protocol Layering , TCP/IP Protocol Suite, The OSI Model, Cross-layer design in emerging networks (e.g., 5G, IoT) Modern trends: convergence with SDN, NFV, cloud-based networking
Physical Layer :- Transmission Media - Guided Media, Un-Guided Media . Case studies on modern broadband deployment, Research challenges in physical media for IoT, underwater, and space networks, Sustainability and green networking in transmission media
Data-Link Layer: Introduction to Data-Link Layer - Introduction, Link-Layer Addressing, Error Detection and Correction - Introduction, Cyclic Redundancy Check. Adaptive error control methods, Reliability in wireless and satellite links, Recent developments in error control coding: Turbo Codes, LDPC, Security implications at the data-link layer.
Data Link Control (DLC) - DLC Services. Media Access Control (MAC) - Random Access, Controlled Access. QoS-aware MAC protocols, MAC in 5G, sensor networks, and IoT, Cognitive MAC and adaptive MAC techniques, MAC layer security challenges and countermeasures
Network Layer: Introduction to Network Layer - Network-Layer Services, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding of IP Packets. Next Generation IP- IPv6 Addressing, The IPv6 Protocol. Network-Layer Protocols - Internet Protocol (IP), Unicast Routing - Introduction, Routing Algorithms- Distance vector and Link State Routing, Unicast Routing Protocols. Software-Defined Networking (SDN) and its impact on the Network Layer, QoS-aware Routing and Traffic Engineering, Network Function Virtualization (NFV) in Routing, IPv6 Security Enhancements and Routing Challenges, Internet-of-Things (IoT) Routing at the Network Layer
Transport Layer: Introduction to Transport Layer-Introduction, Transport-Layer Protocols. Transport Layer Protocols-Introduction, User Datagram Protocol(UDP), Transmission Control Protocol(TCP) , Fast Retransmit and Fast Recovery (TCP Reno, TCP Tahoe), TCP Vegas, TCP Cubic, BBR, Protocol design decisions. Application Layer: Standard Client-Server Protocols-World Wide Web and HTTP, FTP, Electronic Mail, Telnet, Secure Shell (SSH), Domain Name System (DNS), RESTful services and APIs, Content Delivery Networks (CDNs), Application-layer attacks (e.g., DNS poisoning, email spoofing), Application layer in cloud and edge computing environments

Text Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Fifth Edition, McGrawHill
2. "Data and Computer Communications" – William Stallings

NPTEL Courses:

1. Computer Networks And Internet Protocol, IIT Kharagpur
<https://nptel.ac.in/courses/106105183>
2. Computer Networks, IIT Madras
<https://nptel.ac.in/courses/106106091>


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25CSA103 : DATABASE MANAGEMENT SYSTEMS

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

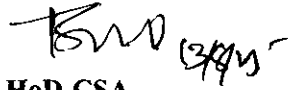
Introduction to Databases: Characteristics of the Database Approach, Advantages of using the DBMS Approach, Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Centralized and Client-Server Architecture for DBMSs. Modern DBMS Architectures: Multi-model databases, cloud-native DBMSs, serverless architecture. A Sample Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design, ER Diagrams, Relational Model: The Relational Model Concepts, Relational Model Constraints and Relational Database Schemas. Basic SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic retrieval Queries in SQL, INSERT, DELETE AND UPDATE Statements in SQL More SQL: More complex SQL retrieval queries Advanced Queries, Specifying constraints as Assertions and Actions as Triggers, Views in SQL Relational Algebra: Unary Relational Operations: Select and Project, Relational Algebra Operations from Set Theory, Binary Relational Operations: Join and Division, Examples of Queries in Relational Algebra. Keys, General definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multi valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form Transaction Processing: Introduction, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability & Serializability, Transaction Support in SQL. Introduction to Concurrency Control: Two-Phase Locking Techniques for concurrency control: Types of Locks and System Lock Tables, Guaranteeing Serializability by Two-Phase Locking. Introduction to Recovery Protocols: Recovery Concepts, No- UNDO/REDO Recovery Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging. Introduction to NoSQL Systems, CAP Theorem, PACELC Theorem, the Consistency-Latency trade-off in distributed systems, NoSQL Data Models: Key-Value Stores, Document Stores, Column-Family Stores, Graph Databases.

Textbooks:

1. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, Seventh edition, Pearson.
2. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pramod J. Sadalage, Martin Fowler, Addison-Wesley (2012)
3. Database Book, The: Principles and Practice Using MySQL, Narain Gehani, 2008

NPTEL Courses:

1. Data Base Management System by Prof. Partha Pratim Das & Prof. Samiran Chattopadhyay, IIT Kharagpur,
<https://nptel.ac.in/courses/106105175>
2. Advanced Distributed Systems, by Prof. Smruti Ranjan Sarangi, IIT Delhi,
<https://nptel.ac.in/courses/106102537>


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25CSA104 : OPERATING SYSTEMS

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

Overview: Introduction: system services and interfaces, Operating-System Operations Operating System Structures: Operating-System Services, OS roles in distributed systems and cloud computing, User and Operating-System Interface, System Calls, role of OS in DevOps. Process Management: Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication. Threads: Overview, Multi-core Programming, Multithreading Models. Process Scheduling: Basic Concepts, Scheduling Criteria, Process lifecycle, 5 state model, task management Scheduling Algorithms (First-Come, First-Served Scheduling, Shortest-Job-First Scheduling, Priority Scheduling, Round-Robin Scheduling.) Process utilities and scripting Process Synchronization: Background, Synchronization Hardware, Semaphores, Deadlocks: Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock. Memory Management: Main Memory: Logical and Physical address map, Memory allocation Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. Virtual Memory: Background, Demand Paging, Page Replacement, Thrashing. Storage Management: File-System Interface: File Concept, Access Methods, Directory and Disk Structure. mounting devices, working with file systems across platforms, FTP/SFTP/NFS, practical backup and automation using scripts. Disk Structure, Disk Scheduling, FCFS Scheduling, SSTF Scheduling, SCAN Scheduling, C-SCAN Scheduling, Selection of a Disk-Scheduling Algorithm.

Text book:

1. Operating System Concepts, Abraham Silberchatz, Peter Baer Galvin, Greg Gagne, Ninth Edition, 2016, Wiley India.
2. Operating Systems, A K Sharma, 2016

NPTEL Courses:

1. Operating System Fundamentals, IIT Kharagpur
<https://nptel.ac.in/courses/106105214>
2. Introduction to Operating Systems, IIT Madras
<https://nptel.ac.in/courses/106106144>

End

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25CSA105 : OBJECT ORIENTED PROGRAMMING

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

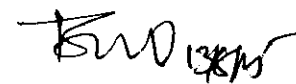
Introduction, Principles of Object-Oriented Languages, Applications of OOP, Programming Constructs, Data Types, Operators Classes and Objects - classes, Objects, Creating Objects, Types of Objects, Passing Objects and passing array of Objects, Methods, constructors - Constructor overloading, cleaning up unused objects -Garbage collector, Class variable and Methods -Static keyword, this keyword, Arrays, Inheritance: Types of Inheritance, Deriving classes using extends keyword, Method overloading, super keyword, final keyword, Abstract class. Interfaces, Packages and Enumeration: Interface -Extending interface, Interface Vs Abstract classes, Packages -Creating packages, using Packages, Access protection, java.lang package. Exceptions & Assertions - Introduction, Exception handling techniques -try... catch, throw, throws, finally block, user defined exception, Exception Encapsulation and Enrichment, Assertions, Multi Threading: java.lang.Thread, The main Thread, Creation of new threads, Thread priority, Multithreading - Using isAlive () and join (), Synchronization, suspending and Resuming threads, Communication between Threads Input/Output: reading and writing data, java.io package, Collections Framework overview, Collection classes- Array List, LinkedList, HashSet. The For-Each loop Mapclass: HashMap, Swing : Introduction, JFrame, JPanel, Components in swings, Layout Managers, JList and JScroll Pane, Split Pane, JTabbedPane, Dialog Box Pluggable Look and Feel. Introduction to JDBC, Database Connectivity, JDBC Architecture, JDBC Drivers, JDBC API, Statement interface, ResultSet interface, PreparedStatement interface, store & retrieve image, file.

Textbooks:

1. Java: The Complete Reference-Herbert Schildt -McGraw-Hill Education
2. Programming with Java: A Primer -E. Balagurusamy -McGraw-Hill Education
3. Object-Oriented Software Engineering Using UML, Patterns, and Java Bernd Bruegge, Allen H. Dutoit---Pearson

NPTEL Courses:

1. Programming In Java, IIT Kharagpur,
<https://nptel.ac.in/courses/106105191>
2. An Introduction to Programming Through C++, IIT Bombay
<https://nptel.ac.in/courses/106101208>


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25CSA106:DATA STRUCTURES AND ALGORITHMS

L-T-P-S: 4-0-0-0

Credits:4

Prerequisites: Nil

Syllabus:

Introduction: Algorithm Specification, Time complexity & space complexity and their notations. Stacks: Definition, operations: array implementation, linked list implementation and applications. Queues: Definition, operations: array implementation, linked list implementation and applications, Circular Queue. Linked lists: Single linked list, double linked list, circular linked list, and operations on linked lists. Trees: Introduction- Terminology, representation of trees, binary trees abstract data type, Properties of binary trees, binary tree representation, binary tree traversals In order, preorder, post order, Binary search trees Definition, searching BST, insert into BST, delete from a BST, Height of a BST. Threaded Binary tree, Height Balanced trees AVL Trees, Binary Heap, B-Tree, B+ Tree, red-black trees, Heaps and Priority Queues: Binary Heap, Min-Heap and Max-Heap, Insert/Delete operations, Heapify and Heap Sort, Fibonacci Heap (Introductory Concepts), Priority Scheduling. Sorting and Searching: Sorting- Bubble, Insertion, Selection, Merge, Quick sort, algorithms Searching- Linear and Binary search, Fibonacci Search algorithms, Graphs: The Graph ADT Introduction, definition, graph representation, elementary graph operations BFS, DFS, Minimum Spanning Tree – only: Prim's and Kruskal's MST. Topological Sort – Dijkstra's algorithm, Bellman-ford (Negative weights) Algorithm. Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing, Double Hashing.

Text Books :

1. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Second Edition, 2002, Pearson.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2010, PHI.
3. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 2020, CareerMonk Publications.

NPTEL Course:

1. Data Structures and Algorithms Design, By Prof. Nitin Saxena, IIT Kanpur Format: Swayam, https://onlinecourses.nptel.ac.in/noc25_cs81/preview
2. Data Structures And Algorithms, IIT Delhi <https://nptel.ac.in/courses/106102064>

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25CSA107: DESIGN AND ANALYSIS OF ALGORITHMS

L-T-P-S: 4-0-0-0

Credits:4

Prerequisites: Nil

Syllabus:

Introduction: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving. Fundamentals of the Analysis of Algorithm Efficiency: Analysis framework and Asymptotic Notations and Basic Efficiency Classes, Amortized Analysis. Randomized Algorithms. Sets & Disjoint set union: introduction, union and find operations. Basic Traversal & Search Techniques: Techniques for Graphs, connected components and Spanning Trees, Bi-connected components and DFS. Introduction to Brute Force Technique, Exhaustive Search, Divide and Conquer: Introduction, General Method, Defective chessboard, Merge sort, Quick sort, Binary Search, Finding Maximum and Minimum, Strassen's Matrix Multiplication. The Greedy Method: The general Method, container loading, Huffman Trees and codes, Minimum Coin Change problem, Knapsack problem, Job sequencing with deadlines, Minimum Cost Spanning Trees, Single Source Shortest paths. Dynamic Programming: The general method, multistage graphs, All pairs-shortest paths, single source shortest paths: general weights, optimal Binary search trees, 0/1 knapsack, reliability Design, The traveling salesperson problem, matrix chain multiplication. Back Tracking: Introduction, n-Queens problem, Sum of subsets, Graph coloring problem, Hamiltonian cycle. Branch and Bound: Introduction, Assignment problem, FIFO Branch-and-Bound, LC Branch-and-Bound, 0/1 Knapsack problem, Traveling salesperson problem. Introduction to Complexity classes: NP-Hard and NP-Complete problems: Basic concepts, Cook's Theorem. String Matching: Introduction, String Matching-Meaning and Application, Native String Matching Algorithm, Rabin-Karp Algorithm, Knuth-Morris-Pratt Automata, Tries, Suffix Tree.

Textbooks:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, " Fundamentals of Computer Algorithms", 2nd Edition, Universities Press.
2. Harsh Bhasin, " Algorithms Design & Analysis", Oxford University Press.

NPTEL Course:

1. Design and Analysis of Algorithms, Chennai Mathematical Institute
<https://nptel.ac.in/courses/106106131>

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25CSA108: IOT DEVELOPMENT AND CONNECTIVITY

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

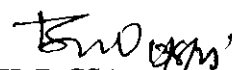
Definition and Characteristics of Internet of Things (IoT) – Key challenges and issues faced in IoT systems – Physical Design of IoT including devices, sensors, and network components – Logical Design of IoT covering data flow and architecture – Functional Blocks of IoT such as sensing, processing, communication, and application layers. Control Units and various Communication Modules including Bluetooth, Zigbee, WiFi, and GPS – Overview of IoT Communication Protocols such as IPv6, 6LoWPAN, RPL, and CoAP – Message Queuing Telemetry Transport (MQTT) protocol – Wired Communication technologies and available Power Sources for IoT devices. The four pillars of the IoT paradigm: RFID (Radio Frequency Identification), Wireless Sensor Networks, Supervisory Control and Data Acquisition (SCADA), and M2M (Machine-to-Machine Communication) – IoT Enabling Technologies such as Big Data Analytics, Cloud Computing, and Embedded Systems. Working principles of sensors – IoT deployment using platforms like Raspberry Pi, Arduino, or equivalent microcontroller-based boards – Reading sensor data and establishing Communication: Connecting microcontrollers with mobile devices via Bluetooth, WiFi, and USB. Introduction to Contiki OS and simulation of IoT networks using Cooja Simulator. Scalability aspects including Network Configuration Protocol and Open vSwitch Database Management Protocol (OVSDB) – IoT Routing Protocols such as Collection Tree Protocol and LOADng. Scope of the Web of Things (WoT) – IoT Data Management including setting up cloud environments, enabling cloud access from sensors, and using data analytics platforms – Resource Identification using Richardson Maturity Model and RESTful APIs. Exploring Business Models for IoT applications – Use cases including green energy buildings and smart infrastructure, smart farming, smart retailing, and smart fleet management.

Text Books

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

NPTEL Courses:

1. Introduction to Internet of Things, IIT Kharagpur, <https://nptel.ac.in/courses/106105166>
2. Introduction to Industry 4.0 and Industrial Internet of Things
https://onlinecourses.nptel.ac.in/noc25_cs146/preview


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25CSA109 : SOFT COMPUTING TECHNIQUES AND APPLICATIONS

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

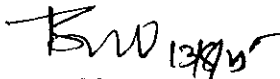
Fundamentals of Soft Computing and Hybrid Intelligence Hard Computing vs. Soft Computing, Characteristics of Soft Computing Techniques, Components of Soft Computing: Fuzzy Logic, Neural Networks, Evolutionary Computation, Probabilistic Reasoning, Hybrid Intelligent Systems, Applications in Engineering, Data Science, Healthcare, etc. Fuzzy Logic Systems and Applications Fuzzy Sets and Membership Functions, Fuzzy Logic Operators, Fuzzy Rules, Fuzzification and Defuzzification Techniques, Mamdani and Sugeno Fuzzy Inference Systems, Adaptive Neuro-Fuzzy Inference Systems (ANFIS) Fuzzy Control Systems, Real-World Applications (Control Systems, Medical Diagnosis, Image Processing) Artificial Neural Networks (ANNs) Biological Neuron Model vs. Artificial Neuron, Feedforward and Feedback Networks, Learning Paradigms (Supervised, Unsupervised, Reinforcement), Back propagation, Perceptron, Multilayer Perceptron (MLP), Self-Organizing Maps (SOM), Deep Learning Basics (CNN, RNN – overview), Applications in Classification, Prediction, Signal Processing Evolutionary Computation and Swarm Intelligence Genetic Algorithms (GA), Selection, Crossover, Mutation, Genetic Programming (GP), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Differential Evolution (DE), Multi-objective Optimization, Hybrid Optimization Techniques Applications and Research Trends in Soft Computing Soft Computing in, Big Data Analytics, IoT and Smart Systems, Biomedical Engineering, Robotics and Automation, Climate and Environmental Modeling, Soft Computing for Decision Support Systems, Tools and Platforms (MATLAB, Python – scikit-fuzzy, PyTorch, TensorFlow), Research Challenges and Future Trends

Textbooks:

1. S. Rajasekaran and G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms
2. J.-S. R. Jang, C.-T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing

NPTEL Courses:

1. Soft Computing Techniques, By Prof. Santimoy Kundu | IIT (ISM) Dhanbad
https://onlinecourses.nptel.ac.in/noc25_ma54/preview
2. Introduction To Soft Computing, By Prof. Debasis Samanta | IIT Kharagpur
https://onlinecourses.nptel.ac.in/noc24_cs37/preview


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25CSA110: ADVANCES IN COMPUTING

L-T-P-S: 4-0-0-0

Credits:4

Prerequisites –Nil

Syllabus:

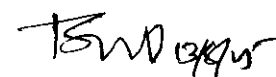
Introduction-Ease of Computing-Scalable Parallel Computer Architecture-Towards Low Cost Parallel Computing and Motivation-Windows of Opportunity-A Cluster Computer and its Architecture-Cluster Classifications-Commodity Components for Clusters-Network Services/Communication-Cluster Middleware and Single System Image-Resource Management and Scheduling-Programming Environments and Tools-Cluster Applications-Representative Cluster System-Cluster of SMPs. Setting up the Cluster- Security-System Monitoring-System Tuning- Resource Sharing-Resource Sharing Enhanced Locality-Prototype Implementation and Extension-Beginning of the Grid-Building blocks of Grid-Grid Application and Grid Middleware-Evolution of the Grid: First, Second & Third Generation-Defining Cloud-Cloud Providers-Consuming Cloud Services-Cloud Models – IaaS, PaaS, SaaS-Inside the cloud-Administering cloud services-Technical interface-Cloud Resources-Cloud Computing and Big Data: Cloud service models (SaaS, PaaS, IaaS), MapReduce and Hadoop, Data storage and processing in the cloud, Big data analytics and real-world applications, Cyber-Physical Systems: Embedded systems and sensor networks, Cybersecurity for IoT, Smart cities and applications. Soft Computing and Artificial Intelligence: Introduction of Soft Computing, Soft Computing vs. Hard Computing, Various Types of Soft Computing Techniques, Applications of Soft Computing, AI Search Algorithm, Predicate Calculus, Rules of Inference, Semantic Networks, Frames, Objects, Hybrid Models.

Text Books:

1. Rajkumar Buyya, High Performance Cluster Computing Vol-1 Architecture and System, Pearson Publication.
2. Berman, Fox and Hey, Grid Computing – Making the Global Infrastructure a Reality, Wiley India.
3. Hurwitz, Bllor, Kaufman, Halper, Cloud Computing for Dummies, Wiley India.

NPTEL Courses:

1. Advanced Computational Techniques, By Prof.Somnath Bhattacharyya | IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc23_ma30/preview


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25CSA111 : MOBILE COMPUTING USING CLOUD

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

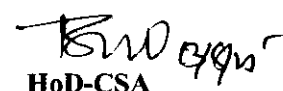
Foundations of Mobile Cloud Computing : Evolution of Mobile Computing to Mobile Cloud Computing, MCC Architecture: Mobile front-end, Cloud back-end, Middleware, Mobile device constraints: Energy, storage, computation limits, Computation offloading models: MAUI, CloneCloud, ThinkAir, Mobile cloud service models: Mobile SaaS, Mobile PaaS, Mobile IaaS, Case studies: Mobile storage apps, mobile gaming platforms, Mobile Networking, QoS, and Security: 4G, 5G, and beyond for MCC SDN and NFV for mobile cloud networking, Latency, bandwidth, and energy-aware QoS models, Cloudlets & edge caching for MCC, Security & Privacy: Data confidentiality, secure offloading, authentication, privacy-preserving computation, Trust models in MCC. Edge/Fog Integration and Emerging Trends: Fog & Edge Computing for MCC: Cloudlets, resource allocation, mobility support, AI/ML in MCC: Context-aware apps, Federated learning on mobile devices, IoT and Big Data in MCC: Smart healthcare, Smart cities, AR/VR mobile applications, Green MCC: Energy-aware resource scheduling and green computing. MCC Simulation Tools: CloudSim, MobiCloudSim, EdgeCloudSim, Performance Metrics: Latency, throughput, energy, cost, Mobile AR/VR, Mobile Healthcare, Cloud gaming. Research Trends, Open Challenges & Case Studies.

Textbooks:

1. Mobile Cloud Computing: Foundations and Research Directions ,Authors: Dijiang Huang, Huijun Wu, Chuang Lin ,Publisher: Springer, 2017
2. Cloud Computing: Theory and Practice , Author: Dan C. Marinescu, Publisher: Elsevier/Morgan Kaufmann, 2nd Edition, 2017Srirama Publisher: Wiley, 2019

NPTEL Courses:

1. Cloud Computing and Distributed Systems, https://onlinecourses.nptel.ac.in/noc21_cs62/preview
2. Edge Computing : https://onlinecourses.nptel.ac.in/noc24_cs66/preview
3. Foundation of Cloud-IoT-Edge-ML : https://onlinecourses.nptel.ac.in/noc23_cs65/preview


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25CSA112: DATA WAREHOUSING AND MINING

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

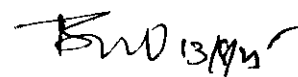
Data Warehousing and Online Analytical Processing: Data Warehouse: Basic Concepts, Data Warehouse Modeling;. Introduction: Fundamentals of data mining: Kinds of data, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Discretization. Mining Frequent Item set, Multi level Associations, Classification: Basic Concepts, Decision Tree Induction – Information gain and Gini Index, Naïve Bayes Classification Methods, Bayesian Belief Networks, Feed forward network, Support Vector Machines, K-Nearest Neighbour, Performance Evaluation Method. Cluster Analysis: Basic Concepts and Methods. Partitioning Methods: k-means and k-medoids, Hierarchical Method: Agglomerative Hierarchical clustering (BIRCH), Density-Based Methods: DBSCAN, Grid-based Methods. Outlier Detection: Outlier Analysis, Cluster Evaluation Methods-Extrinsic and Intrinsic. Mining Sequence Data: Time-Series, Symbolic Sequences, and Biological Sequences.

Text Books:

1. Data Mining – Concepts and Techniques – 3/e, Jiawei Han , Micheline Kamber & Jian Pei- Elsevier.

NPTEL Courses:

1. Business Analytics & Data Mining Modeling using R - By Prof. Gaurav Dixit | IIT Roorkee:
https://onlinecourses.nptel.ac.in/noc25_mg87/preview
2. Data Mining, By Prof. Pabitra Mitra, IIT Kharagpur,
https://onlinecourses.nptel.ac.in/noc20_cs12/preview


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25CSA113: PRINCIPLES OF SOFTWARE RELIABILITY

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

Foundations of Software Reliability: Definition and scope of software reliability, Types of software errors: causes and consequences, Faults, errors, and failures: taxonomy and models, Dependability and fault tolerance in software systems, Basic design principles for reliable software, Requirements engineering for reliability.

Design for Reliability: Software architecture and system-level reliability, Modular design, cohesion, and coupling, Design practices for fail-safe and fail-operational systems, Defensive programming and fault containment, Role of programming style and language features in reliability, Design pattern selection for reliability.

Verification, Testing, and Debugging: Principles of software testing: black-box and white-box, Unit testing, integration testing, system and acceptance testing, Regression testing and test automation, Debugging methods and fault localization, Proving program correctness (formal methods), Reliability metrics and models (e.g., Musa, Jelinski-Moranda).

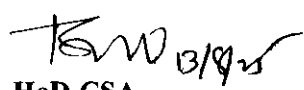
Reliability in Practice and Emerging Directions: Software reliability tools and support systems, Role of compiler and OS architecture in reliability, Reliability in large-scale and real-time systems, Case studies in safety-critical software (aviation, medical, etc.), Reliability in modern paradigms: cloud-native, microservices, and AI systems, Research challenges and open problems in software reliability.

Text Books:

1. "Software Reliability: Principles and Practices" – by Musa, Iannino, and Okumoto
"Software Engineering: A Practitioner's Approach" – by Roger S. Pressman and Bruce R. Maxim.
2. "Reliable Software Technologies – Ada-Europe" (Lecture Notes in Computer Science) – by Various Authors.
3. "Software Testing and Reliability: Theory and Practice" – by Adam Roman

NPTEL Courses:

1. Software Testing, IIT Kharagpur, Prof. Rajib Mall
<https://nptel.ac.in/courses/106105150>
2. Design and Engineering of Computer Systems, By Prof. Mythili Vutukuru | IIT Bombay
<https://nptel.ac.in/courses/106101234>


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25CSA201: HADOOP AND BIG DATA

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

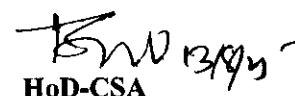
Understanding Big Data: Definition of Big Data, Types of Big Data, How Big Data is Generated, Different source of Big Data Generation, Significance for Big Data, Reason for Big Data, Understanding RDBMS, Future of Big Data, Maintenance or storage of Big data, Big Data use cases for major IT Industries. Python Data Structures Lists: Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions. Introduction to Hadoop: What is Hadoop, Apache Community, History of Hadoop, How is Hadoop Important, Apache Hadoop Ecosystem, Hadoop Architecture, Difference between Hadoop Architecture, Master-Slave Architecture, HDFS and its features, Map Reduce and its features, Map Reduce V1 vs Map Reduce V2, storage options in HADOOP: File Formats and Compression Formats, Encryption, and User Authentication. Python Modules: Creating modules, import statement, Python packages. Introduction to Spark: What is Spark, history of Spark, Theoretical concepts in Spark: Resilient distributed datasets, Directed acyclic graphs, Spark Context, Spark Data Frames, Actions and Transformations, Spark deployment options, Spark APIs. Core Components in Spark : Spark Core, Spark SQL, The Architecture of Spark. Unit testing in Python, Writing Test cases, Running Tests. Sequences and File Operations. Big Data Analytics with Hadoop plus Spark: Limitations of Hadoop, Overcoming limitations of Hadoop, Spark solutions, spark practical on big data analytics, Hadoop Practical on Big data analytics, Hadoop vs. Spark, Why Hadoop plus Spark :Hadoop features, Spark features. Installing Hadoop plus Spark Clusters, Python Libraries, Introduction to files and types of files, Using Databases in Python.

Text Books :

1. Practical Big Data Analytics , Nataraj Dasgupta , 2018, Packt Publishing

NPTEL Courses:

1. Big Data Computing, IIT Patna, Prof. Rajiv Misra
<https://nptel.ac.in/courses/106104189>
2. Scalable Data Science, By Prof. Anirban Dasgupta, Prof. Sourangshu Bhattacharya | IIT
Gadhinagar, IIT Kharagpur
<https://nptel.ac.in/courses/106105186>


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25CSA202: APPLIED ARTIFICIAL INTELLIGENCE

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

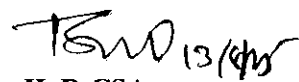
Overview and Historical Perspective, Turing test, Physical Symbol Systems and the scope of Symbolic AI, Agents. State Space Search: Depth First Search, Breadth First Search, DFID. Heuristic Search: Best First Search, Hill Climbing, Beam Search, Tabu Search. Randomized Search: Simulated Annealing, Genetic Algorithms, Ant Colony optimization, PSO, DE, hybrid metaheuristics. Finding Optimal Paths: Branch and Bound, A*, IDA*, Divide and Conquer approaches, Beam Stack Search. Problem Decomposition: Goal Trees, AO*, Rule Based Systems, Rete Net. Game Playing: Planning and Constraint Satisfaction: Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Graph plan, HTN, contingent planning. Constraint Propagation. Logic and Inferences: Propositional Logic, First Order Logic, Soundness and Completeness, Forward and backward chaining. Knowledge and reasoning: knowledge-based agents, Logic, propositional logics and horn clauses, first order logic, Inference in first order logic, Propositional versus first order inference, unification and lifting, forward & backward chaining, resolution. Handling Uncertainty: Quantifying uncertainty, basic probability notation, Baye's theorem, Probabilistic reasoning, representation of conditional distributions, probabilistic reasoning overtime, hidden markov model, Kalman filters Knowledge and reasoning: knowledge-based agents, Logic, propositional logics and horn clauses, first order logic, Inference in first order logic, Propositional versus first order inference, unification and lifting, forward & backward chaining, resolution. Heuristic Search Techniques: Greedy BFS, A*, memory bounded, heuristic functions. Local & Adversarial search: Optimization problems, hill climbing search, simulated annealing, local beam search, genetic algorithms. Online search agents and unknown environments. Optimal decisions in games, alpha-beta pruning, cutting of search, forward pruning, stochastic games, partially observable games. Monte Carlo Tree Search, AlphaZero-style agents. Handling Uncertainty: Quantifying uncertainty, basic probability notation, Baye's theorem, Probabilistic reasoning, representation of conditional distributions, probabilistic reasoning overtime, hidden markov model, Kalman filters , well defined problems and solutions with examples. Applications of AI:- ANN, Fuzzy Systems, NLP, NLP with transformers, semantic parsing. Introduction to Expert systems. Uninformed search strategies-BFS, DFS, Iterative deepening, bidirectional search.

Text Books :

1. Deepak Khemani. A First Course in Artificial Intelligence, McGraw (India), 2013. Hill Education
2. Artificial Intelligence a Modern Approach by Peter Norvig and Andrew Rusell, Third Edition, Prentice Hall.

NPTel Courses:

1. NOC: Artificial Intelligence Search Methods For Problem Solving, IIT Madras Prof. Deepak Khemani, <https://nptel.ac.in/courses/106106256>.
2. NOC: Artificial Intelligence: Knowledge Representation and Reasoning , IIT Madras, Prof. Deepak Khemani, <https://nptel.ac.in/courses/106106140>


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25CSA203 : DATA ANALYTICS WITH PYTHON

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

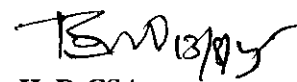
Introduction to Data Analytics and Python : Overview of data science and analytics, types of data and analytical problems, Introduction to Python for data analysis, Python syntax, data types, and control structures. Lists, tuples, sets, dictionaries. Data Loading, Storage, and File Formats: Reading and Writing Data in Text Format, Binary Data Formats, Interacting with Web APIs, Interacting with Databases. Data Cleaning and Preparation: Handling Missing Data, Data Transformation, String Manipulation, try-except blocks, raising and handling exceptions, creating custom exceptions. Data Wrangling and Visualization: Summary statistics and distributions, Data visualization with matplotlib, seaborn, plotly, Descriptive vs inferential statistics. Hypothesis testing, with pandas and numpy: Loading, exploring, and summarizing data, Handling missing data, outliers, and duplicates, Data transformations, merging, reshaping, Cross-Tabulation, Time Series: Date and Time Data Types and Tools, Time Series Basics, Date Ranges, Frequencies, and Hierarchical Indexing, Combining and Merging Datasets, Exploratory Data Analysis, confidence intervals, t-tests, chi-square tests, ANOVA using scipy.stats. Regression Analysis: Simple and multiple linear regression, implementation using stats models and sklearn, Logistic regression, Naive Bayes, KNN, Model evaluation: confusion matrix, precision, recall, F1-score. Unsupervised learning: Clustering - K-means, hierarchical clustering, Dimensionality reduction - PCA, t-SNE, Advanced Machine Learning for Analytics: Decision trees, random forests, boosting (XGBoost), Cross-validation, hyper parameter tuning.

Textbooks:

1. Python for Data Analysis, 3rd Edition, Wes McKinney, O'Reilly Media
2. Doing Data Science: Straight Talk From The Frontline, 1st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013.

NPTEL Courses:

1. Data Analytics with Python, By Prof. A Ramesh, IIT Roorkee
https://onlinecourses.nptel.ac.in/noc20_cs46/preview
2. Data Science for Engineers, By Prof. Shankar Narasimhan, Prof. Ragunathan Rengasamy, IIT Madras, <https://nptel.ac.in/courses/106106179>


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25CSA204: APPLIED MACHINE LEARNING

L-T-P-S: 4-0-0-0

Credits:4

Prerequisites –NIL

Syllabus:

Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning Concept learning and the general to specific ordering – introduction, a concept learning task, concept learning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination, inductive bias. Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning. Artificial Neural Networks-1– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm. Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, advanced topics in artificial neural networks. Reinforcement Learning – Introduction, the learning task, Q-learning, non-deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming Evaluation Hypotheses –Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms. Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm. Computational learning theory –Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning.

Textbooks:

1. Machine Learning – Tom M. Mitchell, - MGH
2. Machine Learning: A Hands-on Approach, C R Rene Robin, Doreen Robin, Chandra Mouli P V S S R.2025

NPTEL Courses:

1. Introduction to Machine Learning - IITKGP, IIT Kharagpur
<https://nptel.ac.in/courses/106105152>
2. Machine Learning for Engineering and science applications, IIT Madras
Prof. Balaji Srinivasan Prof. Ganapathy Krishnamurthi,
<https://nptel.ac.in/courses/106106198>

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25CSA205 :PROGRAMMING IN PYTHON

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

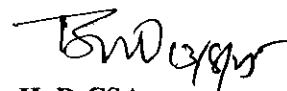
Introduction to python, Installations IDLE, Jupyter notebook Python Elements of Python , Python Interpreter, Python shell, Indentation, Identifiers and keywords , Literals, Strings, Python Data Types, Type conversions Expressions, Variables and Assignments, Types of Operators, Input and Output Statements, Conditional Statements Control statements : while and for statements, nested loops, Difference between break, continue and pass, return ,Strings, Lists, Tuples, Dictionary, set, frozen set ,Date and time, Defining Function, User-Defined Functions, Passing Arguments and Lambda Functions, map, filter, reduce, decorators, Types of arguments ,Packages, Modules, import statement, standard library modules(math, os, sys, datetime, random) Creating class and objects, Constructors, static methods, Inheritance, polymorphism, Abstract classes, Exception Handling, regular expressions Event Driven Programming, GUI Programming ,, Graphical User Interfaces: Basics of tkinter GUI Development, Event- Based tkinter Widgets, File handling Database Programming, ,numpy, pandas, matplotlib, Python Client server programming with Python,

Textbooks:

1. Ljubomir Perkovic, "Introduction to Computing Using Python: An Application Development Focus", Wiley, 2012.
2. R. Nageswara Rao Core Python Programming Paperback, 2018

NPTEL Course:

3. The Joy of Computing using Python By Prof. Sudarshanlyengar, Prof. Yayati Gupta | IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs32/preview


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25CSA206: SECURING WEB SYSTEMS AND NETWORKS

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

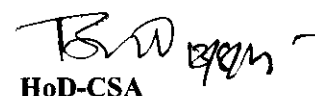
Foundations of Web Technologies and Communication : HTML, CSS, JS, URLs, DOM, Frames, HTTP, Navigation, X-Domain communication, web security, Security elements, Implementation of safety assessment, understanding the dangers of an insecure communication channel, Network Attacks & HTTPS. Secure Communication and HTTPS Ecosystem: HTTPS deployment, HTTPS impact on your application, Insights into the latest evolutions for HTTPS deployments, HTTP/1.1 and HTTP/2 – Methods, Headers, Status Codes Cross-domain Communication: CORS, JSONP, and WebSockets, Limitations of HTTPS, HSTS (HTTP Strict Transport Security), HTTPS Evolution and Challenges (TLS 1.3, QUIC), Cookie Flaws and Server Misconfiguration. Security of Browser same origin policy, sandbox browser, malicious URL intercept, Rapid development of browser security, cross-site scripting attack Web Application Vulnerabilities and Attacks: Advanced XSS attack, XSS defence, Cross-Site Request Forgery, Advanced CSRF defence, Clickjacking, HTML5 Securities, other security problems. Injection Attacks, SQL injection attacks, Database attacking techniques properly defending against SQL injection and other injection, File Upload Vulnerability, designing secure file upload features Authentication, Session Management, and Access Control: Authentication and session management, Attacks on User Interfaces, Access control, Encryption algorithms and random numbers, Web framework security, Application-layer Denial-of-Service Attacks, PHP security, TCP Reset Attack. Security of Internet Business, Business logic security, How the account is stolen, Internet garbage phishing, Web Framework Security Best Practices ,Application-Layer DoS Attacks (Slowloris, HTTP flood) Security Operations, Business Logic, Privacy, and Future Trends: User privacy protection ,Security development lifecycle, Security operations, Process of vulnerability patch, security monitoring, Practical ways to secure the authentication process, prevent authorization bypasses and harden session management mechanisms (10) security planning, business continuity planning, Handling incidents Risk Analysis, Dealing with disaster: privacy on the web, Privacy impacts of emerging technologies, Handling incidents, Risk Analysis, Dealing with disaster: privacy on the web, Privacy impacts of emerging technologies, Browser Design & Flaws. Secure Authentication Planning and Secure Deployment. Security Monitoring and Logging. Disaster Recovery in Case of Breach

Text Books:

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications (1 ed.), O'Reilly Media, 2020. ISBN 978- 1492053118.
2. High Performance Browser Networking– Ilya Grigorik (O'Reilly)
3. Cybersecurity for Executives – Gregory J. Touhill
4. Mozilla Developer Network (MDN): <https://developer.mozilla.org>

NPTEL Course:

1. Network Security, By Prof. Gaurav S. Kasbekar | IIT Bombay
https://onlinecourses.nptel.ac.in/noc25_ee54/preview


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25CSA207:PYTHON FOR DATA SCIENCE

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

Fundamentals of Python Programming: Data types in Python, Operators in Python, Input and Output Statements, Control Statements. Arrays: Creating, Processing Array Elements and handling Array Operations. Strings Characters: Creating, Indexing, Slicing, Repeating and Concatenation, Comparing, removing spaces, Finding sub strings in String. Functions: Defining, Calling Returning results from a function. Pass by Object Reference, Formal, Actual, Positional, Keyword, Default, Variable Length Arguments. Local and Global Variables. Lists: Creating List using range () function, Updating the elements of a list, Concatenation of two list, Repetition of lists, Membership in lists, Aliasing and Cloning lists, Sorting list elements, Nested lists. Tuples: Creating and Accessing Tuple Elements, Basic Operation on

Tuples, Nested Tuples, Inserting, Modifying and Deleting Elements of a Tuple. Dictionaries: Operation on Dictionaries, Dictionary Methods, Sorting Elements of a Dictionary, Converting Lists into Dictionary. Introduction to data structures used in data science. Introduction to Pandas Library ,Creating Data Frames from: Excel Spreadsheets ,CSV Files, Dictionaries and Tuples. Data Frame Operations: Selecting, Filtering, Adding, Removing Data, Indexing and Reindexing, Sorting and Aggregation, Reading large datasets efficiently using libraries .Handling Missing Data ,Data Type Conversion, Renaming Columns and Indexing, Merging and Joining Data Frames. Using Matplotlib and Seaborn Libraries, Creating Bar Graphs, Histograms, Pie Charts, and Line Graphs, Customizing Plots (Titles, Labels, Legends, Colors), Visualizing Data Trends for Analysis, Advanced Seaborn Plots: Boxplots, Heatmaps , Customizing Plots: Labels, Legends, Color Palettes. Feature distributions and relationships, Confusion matrix and feature importance using Seaborn heatmaps, Classification models using Scikit-learn, Case studies: Predicting price of pre-owned cars, Classifying personal income.

Textbook:

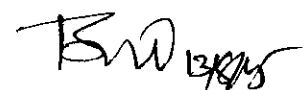
4. R Nageswara Rao, "Core Python Programming", Dreamtech Press, 2018 Edition.

Reference Books:

1. Mark Lutz, "Programming Python", 4th Edition, O'Reilly Media.
2. Timothy A. Budd, "Exploring Python", , McGraw Hill Education, 2nd Reprint 2015
3. Paul Gries, Jennifer Campbell, Jason Montojo, "Practical Programming: An Introduction to Computer Science Using Python 3" (Pragmatic Programmers) Second Edition

NPTEL Course:

1. Probability Theory for Data Science By Prof. Ishapathik Das | IIT Tirupati |12 Weeks
https://onlinecourses.nptel.ac.in/noc25_ma95/preview


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25CSA208 : THE JOY OF COMPUTING USING R PROGRAMMING

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

Introduction, Reserved Words, Variables & Constants, Operators, Operator Precedence, Decision: if...else, if else () Function. for loop, while Loop, break & next, repeat Loop. Functions, Function Return Value, Environment & Scope, Recursive Function, R Infix Operator, switch, Vectors, Matrix, List, Data Frame, Factor. Descriptive statistics in R: Introduction, Data, Minimum and maximum, Range, Mean, Median, Mode, First and third quartile, other quartiles, Interquartile range, Standard deviation, and variance. Histogram, Bar plot, Coefficient of variation, Boxplot, Contingency table – Mosaic Plot. Probability Distributions – Binomial, Bernoulli, Geometric, Poisson, Exponential, Normal, Uniform distributions. Correlation & Regression - Introduction, Correlation & Regression plot - Scatterplot, Line plot, Classification using logistic regression. Hypothesis testing – Introduction, Hypothesis tests - Proportions, Diff between props, Mean, Diff between means, Diff between pairs, Goodness of fit test- Chi- square test.

Text Books:

1. Vincent Zoonekynd, Statistics With R
2. Salvatore S. Mangiafico, Summary and Analysis of Extension Program Evaluation in R.
3. Hadley Wikham & Garrett Grolemond, R for Data Science, O'Reilly Publications

NPTEL Course:

1. Introduction to R Software, By Prof. Shalabh | IIT Kanpur
https://onlinecourses.nptel.ac.in/noc19_ma33/preview

BW 13/8/15

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25CSA209 – APPLIED DEEP LEARNING

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

Feed forward networks and training, Machine learning vs and Deep learning, Activation functions, initialization, regularization, batch normalization, model selection, ensemble techniques, Convolutional neural networks, Fundamentals, architectures, pooling, visualization Deep learning for spatial localization, Transposed convolution, efficient pooling, object detection, semantic segmentation. Recurrent neural networks Recurrent neural networks (RNN), long-short term memory (LSTM), language models, machine translation, image captioning, video processing, visual question answering, video processing, and learning from descriptions Deep generative models, Boltzmann Machine and Auto-encoders, variational auto- encoders, generative adversarial networks, autoregressive models, generative image models. Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam. Deep reinforcement learning, Temporal difference learning, Policy gradient methods, Q-learning, Deep Q-Learning.

Textbook:

2. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016. <http://www.deeplearningbook.org>.

NPTEL Course:

1. Deep Learning, By Prof. Prabir Kumar Biswas | IIT Kharagpur
https://onlinecourses.nptel.ac.in/noc20_cs62


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25CSA210 : CLOUD INFRASTRUCTURE WITH SERVICES

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

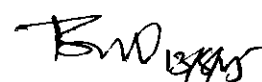
Cloud Infrastructure Foundations & Virtualization: Introduction to Cloud Computing, Evolution, definitions, Cloud Architecture, Cloud deployment models: Public, Private, Hybrid, Community, Service models: IaaS, PaaS, SaaS, FaaS (Server less), Cloud Infrastructure, Types of virtualization, Hypervisors (Type I & II), VM migration, resource pooling, Software-defined networking (SDN) & Software-defined storage (SDS), Containers vs Virtual Machines. Distributed Systems, Networking & Security in Cloud: Distributed Computing Principles, Resource allocation, scheduling, load balancing, Distributed storage (Object, Block, File, No SQL & New SQL), Cloud Networking, Virtual networks, Content Delivery Networks (CDNs), Cloud Security & Compliance, Identity and Access Management (IAM), Multi-tenancy security, encryption, key management. Cloud Services, Edge & Emerging Paradigms: Cloud Services Programming Models, Infrastructure as Code (IaC): Terra form, AWS Cloud Formation, Serverless computing, Dataflow), Data lakes & data pipelines, Edge & Fog Computing, Hybrid cloud-edge architectures micro services architecture, API gateways, Big Data & Analytics in Cloud, Batch vs streaming analytics (Spark, EMR, IoT-cloud integration. Cloud Simulation & Performance Evaluation: CloudSim, iCanCloud, GreenCloud simulation frameworks, Benchmarking cloud services: performance, cost, energy efficiency, Containerization & Orchestration, Docker, Kubernetes, and orchestration frameworks, Performance isolation, auto-scaling strategies, Case Studies & Industry Practices: AWS, Azure, and GCP comparative study.

Textbooks:

1. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley, 2011
2. Cloud Computing: Theory and Practice, Dan C. Marinescu, Elsevier/Morgan Kaufmann, 2017 (2nd Ed.)
3. Mastering Cloud Computing: Foundations and Applications Programming
Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, McGraw Hill

NPTEL Courses:

1. Cloud Computing : https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. Cloud Computing and Distributed Systems:
https://onlinecourses.nptel.ac.in/noc21_cs15/preview


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25CSA210: SERVICE MANAGEMENT AND CLOUD COMPUTING

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

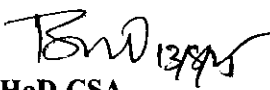
Introduction to Service Management- Concepts of Service Management:Definition and characteristics of services,Service lifecycle,Service vs. product IT Service Management (ITSM):Overview of ITIL framework,Service Strategy, Design, Transition, Operation & Improvement Service Quality:Service level management,Key performance indicators (KPIs),Service level agreements (SLAs) Fundamentals of Cloud Computing Introduction to Cloud Computing:Evolution of cloud computing,Characteristics of cloud (on-demand, elasticity, multi-tenancy) Cloud Service Models:Infrastructure as a Service (IaaS),Platform as a Service (PaaS),Software as a Service (SaaS) Deployment Models:Public, Private, Hybrid, and Community Clouds Cloud Infrastructure and Technologies- Cloud Architecture:Frontend, backend, and network components,Virtualization technologies (VMs, Containers, Hypervisors)Cloud Storage and Databases:Object storage (e.g., Amazon S3),Distributed databases Cloud Networking:Load balancing,Content delivery networks (CDNs),Security aspects (firewalls, VPNs) Cloud Platforms and Service Providers- Major Cloud Providers:AWS, Microsoft Azure, Google Cloud Platform (GCP)Comparative Analysis:Services, pricing, regions

Cloud Tools & Services:Compute: EC2, Azure VM, GCE,Storage: S3, Blob Storage, Cloud Storage,Serverless: AWS Lambda, Azure Functions Service & Cloud Governance, Trends and Case Studies-Cloud Governance and Compliance:Policies, data privacy, and regulatory compliance (e.g., GDPR) Service Security & Risk Management:Identity & Access Management (IAM),Business continuity and disaster recovery Emerging Trends:Edge computing, Multi-cloud, DevOps, AI in cloud.

Text Books

1. Foundations of IT Service Management: Based on ITIL by Jan Van Bon
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl

NPTEL Courses: Cloud Computing ,By Prof. Soumya Kanti Ghosh | IIT Kharagpur,
https://onlinecourses.nptel.ac.in/noc25_cs11/preview


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25CSA212: DATA MANAGEMENT IN CLOUD COMPUTING

L-T-P-S: 4-0-0-0

Credits: 3

Prerequisites –Nil

Syllabus:

Energy efficiency in clouds; Market-based management of clouds; Federated clouds/Intercloud; Third-party cloud services; Resource allocation; Task scheduling-Service management; Data management; Resource management; Security and privacy; Edge computing; Fog computing; Osmotic computing-Toolkits: CloudAnalyst; CloudSim; iFogSim; Haizea – An open source VM-based lease manager-Virtualization: Introduction; Characteristics of virtualized environments; Taxonomy of virtualization techniques; Virtualization and cloud computing; Pros and cons of virtualization; Technology examples-Indexing and searching in cloud databases . Data Security and Privacy in the Cloud-Cloud security models and responsibilities, Encryption and key management, Compliance and data privacy regulations, Scalability and Performance Optimization, Horizontal and vertical scaling Load balancing and auto-scaling Caching and optimization techniques, Data Backup and Disaster Recovery Backup strategies and best practices, High availability and fault tolerance-Overview of Big Data, Stages of analytical evolution, State of the Practice in Analytics, The DataScientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle, Operationalizing BasicData Analytic Methods Using R, Advanced Analytics - Analytics for Unstructured Data - Map Reduceand Hadoop, The Hadoop Ecosystem, In-database Analytics, Data Visualization Techniques, StreamComputing Challenges, Systems architecture, Main memory data management techniques, Energyefficient data processing, Benchmarking, Security and Privacy, Failover and reliabilityData Analytics and Machine Learning Big data frameworks (e.g., Hadoop, Spark) Cloud-based analytics and machine learning platforms, Data preprocessing and modelling, Serverless Computing and Data Processing Serverless architecture (e.g., AWS Lambda, Azure Functions) Event-driven data processing Stream processing and real-time analytics. Cloud Data Governance and Compliance -Data governance frameworks, Regulatory compliance, Data lifecycle management.

Text Books:

1. Bill Franks, Taming The Big Data Tidal Wave, 1st Edition, Wiley, 2012.
 2. Frank J. Ohlhorst, Big Data Analytics, 1st Edition, Wiley, 2012.
 3. Christian Crumlish and Erin Malone, Designing Social Interfaces, O'Reilly Media, 2009.
- EdBurnett, Hello, Android. Introducing Google's Mobile Development Platform, Fourth Edition, Pragmatic Bookshelf, 2015.

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25CSA213: SECURING CLOUD COMPUTING ENVIRONMENTS

L-T-P-S: 4-0-0-0

Credits:4

Prerequisite: Nil

Syllabus:

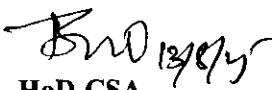
Introduction to cloud service models (IaaS, PaaS, SaaS), deployment models (public, private, hybrid, multi-cloud), understanding the shared responsibility model, cloud-specific security concerns and strategies, Concepts of RBAC, policy-based access, single sign-on (SSO), multi-factor authentication (MFA), identity federation, IAM for cloud-native applications, Techniques for data encryption at rest and in transit, key management practices, data masking, tokenization, data loss prevention (DLP) mechanisms, data residency, and sovereignty, Securing virtual networks (VPCs), firewalls and security groups, intrusion detection/prevention systems (IDS/IPS), web application firewall (WAF), API security, secure serverless computing practices, Common cloud security threats (data breaches, insider threats, DDoS, misconfigurations), vulnerability assessments and penetration testing, threat modeling and risk analysis, Security monitoring tools and logging in cloud environments, Security Information and Event Management (SIEM), cloud audit logging, incident response planning and execution, Cloud regulatory compliance frameworks (GDPR, HIPAA, PCI-DSS), international data transfer laws, security policies, vendor risk assessments, service-level agreements (SLAs), legal considerations in cloud contracts, Security by design, integrating security in CI/CD pipelines (DevSecOps), automation tools, secure software development lifecycle (SDLC), zero-trust architecture, continuous compliance.

Textbooks:

1. The Art of Scalability: Scalable Web Architecture, Processes, and Organizations for the Modern Enterprise by Martin L. Abbott and Michael T. Fisher.
2. Data Governance: How to Design, Deploy, and Sustain an Effective Data Governance Program by John Ladley.

NPTEL Courses:

1. Cloud Computing, By Prof. Soumya K. Ghosh, IIT Kharagpur
<https://nptel.ac.in/courses/106105167>
2. Introduction to Industry 4.0 and Industrial Internet of Things, By Prof. Sudip Misra, IIT Kharagpur, <https://nptel.ac.in/courses/106105195>


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Annexure IV

B.Sc. AI&ML PROGRAM STRUCTURES

SEM	AI&ML Course Title	L	T	P	S	Cr	CH
1	Mathematics for Computing	3	1	0	0	4	4
1	Probability & Statistics I	3	1	0	0	4	4
1	Programming in Python & Data Structures	3	0	2	0	4	5
1	Discrete Mathematics & Logic	3	1	0	0	4	4
1	Introduction to Artificial Intelligence	3	0	2	0	4	5
1	Communication & Professional Skills	2	0	0	4	3	6
2	Machine Learning I	3	1	2	0	5	6
2	Data Structures & Algorithms	3	0	2	0	4	5
2	Databases & SQL	3	0	2	0	4	5
2	Open Elective (Healthcare/Finance Basics)	3	0	0	0	3	3
2	Advanced Linear Algebra & Optimization	3	1	0	0	4	4
3	Machine Learning II	3	1	2	0	5	6
3	Deep Learning Basics	3	1	2	0	5	6
3	Optimization Techniques for ML/DL	3	0	2	0	4	5
3	Computational Stats & Bayesian Learning	3	1	0	0	4	4
3	OS & Cloud for AI	3	0	2	0	4	5
3	Domain Elective I	3	0	0	0	3	3
4	Reinforcement Learning & Decision Intelligence	3	1	2	0	5	6
4	Natural Language Processing	3	1	2	0	5	6
4	Computer Vision & Multimodal AI	3	1	2	0	5	6
4	Graph Neural Networks & Knowledge Graphs	3	0	2	0	4	5
4	Ethics, Fairness, Accountability	2	1	0	0	3	3
4	Domain Elective II	3	0	0	0	3	3
5	Large Language Models & Prompt Engineering	3	1	2	0	5	6
5	Generative AI (GANs, Diffusion Models)	3	1	2	0	5	6
5	Multimodal Intelligence (Vision-Language)	3	1	2	0	5	6
5	Applied ML in Healthcare	3	0	2	0	4	5
5	Applied ML in Fintech	3	0	2	0	4	5
5	Seminar & Project Proposal	2	0	0	4	3	6
6	Capstone Project	0	0	4	8	6	12
6	MLOps & AIOps	3	0	2	0	4	5
6	AI & Cybersecurity	3	0	2	0	4	5
6	Entrepreneurship in AI/DS	2	1	0	0	3	3
6	Edge AI & AIoT	3	0	2	0	4	5
6	Scalable AI Systems	3	0	2	0	4	5

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B.Sc. AI&DS PROGRAM STRUCTURE

SEM	AI&DS Course Title	L	T	P	S	Cr	CH
1	Mathematics for Computing	3	1	0	0	4	4
1	Probability & Statistics I	3	1	0	0	4	4
1	Programming in Python & Data Structures	3	0	2	0	4	5
1	Discrete Mathematics & Logic	3	1	0	0	4	4
1	Introduction to Data Science & AI	3	0	2	0	4	5
1	Communication & Professional Skills	2	0	0	4	3	6
2	Machine Learning I	3	1	2	0	5	6
2	Data Structures & Algorithms	3	0	2	0	4	5
2	Databases & SQL	3	0	2	0	4	5
2	Open Elective (Healthcare/Finance Basics)	3	0	0	0	3	3
2	Probability & Statistics II	3	1	0	0	4	4
3	Machine Learning II	3	1	2	0	5	6
3	Deep Learning Basics	3	1	2	0	5	6
3	Data Visualization & Storytelling	2	0	2	4	4	8
3	Optimization for Data Science	3	0	2	0	4	5
3	Big Data Ecosystems	3	0	2	0	4	5
3	Domain Elective I	3	0	0	0	3	3
4	Reinforcement Learning & Decision Intelligence	3	1	2	0	5	6
4	Natural Language Processing (Applications)	3	1	2	0	5	6
4	Applied Predictive Analytics	3	0	2	0	4	5
4	Advanced Deep Learning	3	1	2	0	5	6
4	Data Security, Privacy & Ethics	2	1	0	0	3	3
4	Domain Elective II	3	0	0	0	3	3
5	Advanced Data Science (Causal Inference)	3	1	2	0	5	6
5	Generative Models & LLMs	3	1	2	0	5	6
5	DS in Healthcare	3	0	2	0	4	5
5	DS in Finance	3	0	2	0	4	5
5	Cloud & Scalable DS Pipelines	3	0	2	0	4	5
5	Seminar & Project Proposal	2	0	0	4	3	6
6	Capstone Project	0	0	4	8	6	12
6	MLOps & AIOps	3	0	2	0	4	5
6	DS for Cybersecurity & Risk	3	0	2	0	4	5
6	Entrepreneurship in AI/DS	2	1	0	0	3	3
6	Data Engineering Pipelines	3	0	2	0	4	5
6	Scalable Data Systems	3	0	2	0	4	5

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Department of Computer Science and Applications Minutes of the DAC meeting held on 09-08-2025 at 4.00 P.M VENUE : S518

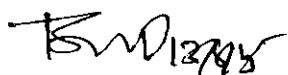
Agenda Items:

1. To review the existing structures of BCA and MCA..
2. To discuss the revision of paper 2 and paper 3 of Ph.D
3. To analyze the current Specializations of BCA and MCA..

This meeting is chaired by Dr.K.Bhagavan, Chair Person, HOD, Department of CSA

Members:

S.No	Name of the Member	Designation / Role in Committee
1	Dr. K. Bhagavan	Chairperson
2	Dr.K.Kiran Kumar	Professor
3	Dr. C.M.Sheela Rani	Professor
4	Dr.V.Valli Mayil	Professor
5	Dr.MNV Kiran Babu	Assoc. Professor
6	Dr. B.Mouleswararao	Assoc. Professor
7	Dr. V.S Narayana Tinnaluri	Assoc. Professor
8	Dr. Y.Rama Krishna	Asst. Professor
9	Dr. Chunduri Kiran Kumar	Asst. Professor
10	Mr. A.Siddhartha Reddy	Asst. Professor



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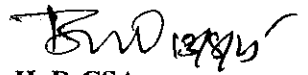
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11	Dr. N.Venkata Ramana	Asst. Professor
12	Dr.Jeevan Jala	Asst. Professor
13	Mrs. T.Ratna Kumari	Asst. Professor
14	Dr. Ch.Madhava Rao	Asst. Professor
15	Dr.M.Ragini	Asst. Professor
16	Mrs.V.Swathi	Asst. Professor
17	Mrs.T.Hema Latha	Asst. Professor
18	Dr.B. Krishna Prasad	Asst. Professor
19	Dr. K.Chandrabhushana Rao	Asst. Professor
20	Mrs. Ch. Satya Keerthi.N.V.L	Asst. Professor
21	Dr. G.Venkateswarlu	Asst. Professor
22	R. Lalith Kumar	3 rd Year-Student Representative -BCA
23	Syed Arafath Ali	3 rd Year-Student Representative -BCA
24	Kotaru Lakshmi Sowmya	2nd Year-Student Representative-MCA
25	Dasari Subha Sri	2nd Year-Student Representative-MCA


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Minutes of Meeting:

1. It is recommended to refine the structures of BCA and MCA.
2. Stakeholders' suggested modifying the whole structure of MCA as per the industry needs.
3. It is decided to revise Paper-1 and Paper-2 Ph.D Courses in Computer Science.
4. The Department Academic Committee's suggestions are discussed, and key proposals such as integrating research-oriented learning are considered.
5. Faculties Dr. Sabena banu and Dr Chandra Bhushan suggested to include few AI related courses in the curriculum of BCA from Y25 regulation.
6. Faculty Mrs. Ratna Kumari suggested to include a course that showcases the front end development frame work which is useful to students.
7. Smt. Sri Leela, Industrial peer suggested to include a course to give the knowledge on the concepts of block chain and Fintech. .
8. Dr. E. Suresh Babu, Academic Peer proposed a course on Full Stack Application Development.
9. Dr. Ch. Madhava Rao and Dr. Jeevan Jala suggested integrating modules on research ethics, scholarly publishing tools, and data analysis using Python/R.
10. Dr. MNV Kiran Babu further proposed the inclusion of emerging computing paradigms such as Artificial Intelligence (AI), Machine Learning (ML), and Quantum Computing to enhance the relevance and future-readiness of the Ph.D. coursework.
11. Mr. Rajesh Kumar, Industry Expert from TCS, recommended merging the current Data Science and Artificial Intelligence specializations into a single specialization named "AI & Data Science" for the Y25 batch, highlighting industry demand for integrated skillsets in both domains.
12. Suggestions were received from Dr. V.S. Narayana Tinnaluri and Mrs. V. Swathi to add electives on UI/UX Design, Cybersecurity Fundamentals, Mobile Application Development, and Data Visualization Tools.
13. Student representatives, Syed Arafath Ali and Kotaru Lakshmi Sowmya, highlighted growing interest among peers for **Front-End Development Frameworks** such as **React, Angular, and Vue.js**.
14. The committee proposed offering value-added certification courses in collaboration with platforms like NPTEL, Coursera, and Infosys Springboard.
15. The committee suggested to include Full Stack Development, Cloud Foundations, Cybersecurity Awareness, and Data Analytics using Python.

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