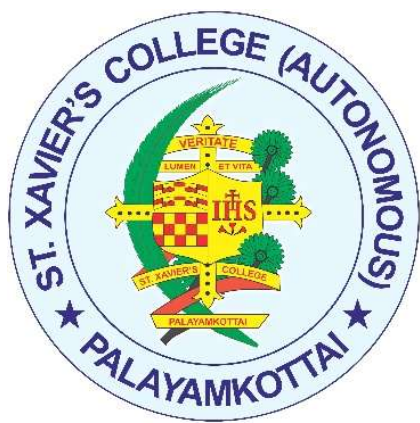


M.Sc. Computer Science

LOCF SYLLABUS 2026



Department of Computer Science

School of Computing Sciences

St. Xavier's College (Autonomous) Palayamkottai

Tirunelveli – 627 002, Tamil Nadu, India

Vision

To mould young men and women as leaders in all walks of life so that they may serve the people especially the poor and the oppressed of our nation in truth, justice and love.

Mission

To achieve a synthesis of academic excellence and the formation of character.

To ensure social justice through equity and access

To include the excluded for empowerment

To equip students with global competencies

To engage in relevant research activities.

To promote Lab to Land through the Outreach Programme – Student Training and Action for Neighbourhood Development (STAND)

SCHOOLS OF EXCELLENCE WITH CHOICE-BASED CREDIT SYSTEM (CBCS)

Essential Features of CBCS

Standardisation of degree courses to internationally accepted levels

Focus on skill-based curriculum

Emphasis on value education

Institution - Industry collaboration

Provision for earning more credits

Development of communication skills

Post Graduate Courses

The existing PG curriculum was thoroughly upgraded based on the expectations of the academicians and the aspirations of the student community. The PG syllabus has two parts : Core and Elective. The minimum number of credits to be earned by a student is 100. The aim of the project work at the PG level is to develop the skill of solving problems and to promote research motivation. All the I-year PG students are offered one Value - Added Course and during their II year they are supposed to do one Extra Credit course outside their class hours to enhance their employability skills. However, during every semester, they are free to learn one ECC paper, offered by the respective departments.

Credit system

The credit system at St. Xavier's College (Autonomous) assigns weightage to courses based on the hours allocated to each course. Typically, one credit is equivalent to one hour of instruction per week. However, credits are awarded regardless of actual teaching hours to ensure consistency and adherence to guidelines. The credits and hours allotted to each course within a programme are detailed in the Programme Pattern table. While the table provides a framework, there may be some flexibility due to practical sessions, field visits, tutorials, and the nature of project work. For postgraduate (PG) courses, students are required to accumulate

a minimum of 100 credits, as stipulated in the programme pattern table. The total number of courses offered by the department is outlined in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)

Outcome-Based Education (OBE) is a student-centric teaching and learning methodology that focuses on measuring student performance through clearly defined outcomes. For St. Xavier's College, with its commitment to excellence and NAAC/NBA accreditation requirements, OBE is not just a regulatory expectation but a pathway to academic quality, global competitiveness, and improved employability of graduates.

We prepare students to meet future industry requirements and reinforce St. Xavier's College, Palayamkottai, as a leader in quality higher education. St. Xavier's College introduced OBE in 2018, and for the Attainment Calculation, we developed our own method in 2018. From the academic year 2025-26 onwards, in examinations, for each question we mark Course Outcome (CO), Competency and Performance Indicator, Programme Outcome / Programme Specific Outcome, Bloom's Revised Cognitive Level and we follow the OBE procedure for the calculation of the Attainment of Outcome for each student, course, semester, programme.

EVALUATION PATTERN (PG)

Continuous Internal Assessment

There is no internal minimum for any paper. However, Continuous Internal Assessment (CIA) is a mandatory requirement for all students. A student must take at least one CIA test out of two tests and must fulfil at least one mode of assessment among assignments, quiz, seminars, etc., otherwise he/she will not be permitted to write the semester examination.

S.No	Component	Marks Allotted
1	I CIA Test	70
2	II CIA Test	70
	Total	140

The total CIA marks of 140 will be converted to 70 marks. An additional 30 marks will be awarded through other internal assessment components.

The Continuous Internal Assessment (CIA) consists of two component tests, each carrying 15 marks (15 + 15).

The final internal assessment marks will be calculated out of 100 (70 + 30). The obtained marks will be **converted to 50 marks**.

Semester (External) Examination

- The External Semester Examination will be conducted for **100 marks**.
- The obtained marks will be **converted to 50 marks**.

Question Pattern

PG Semester Examinations (3 Hours)

PART	TYPE	Mark Distribution	Total Marks
A	MCQ	10X1	10
B	ALL	5X3	15
C	Either/or	5X6	30
D	3 out of 5	3X15	45
		Total	100

PG Internal Examinations (2 Hours)

PART	TYPE	Mark Distribution	Total Marks
A	MCQ	10X1	10
B	ALL	3X3	09
C	Either/or	3x7	21
D	3 out of 5	3X10	30
		Total	70

Grading System

Range of Marks	Letter Grade	Grade Point	Description
90-100	A+	9.0-10.0	Outstanding
80-89	A	8.0-8.9	Excellent
70-79	B+	7.0-7.9	Very Good
60-69	B	6.0-6.9	Good
50-59	U	5.0-5.9	Average
00-49	U	0	Reappear

PROGRAMME OUTCOMES (PO) FOR PG PROGRAMMES

Students of all Postgraduate Degree Programmes at the time of graduation will be able to attain the following:

PO1. Critical Thinking: Acquire the knowledge in the respective field and take informed actions.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems and apply ethical principles and commit to professional ethics and responsibilities and norms of different value systems.

PO6. Environment and Sustainability: Demonstrate the issues of environmental contexts and sustainable development.

PO7. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern IT tools including prediction and modeling to complex activities with an understanding of the limitations.

PO8. Self-directed and Life-long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO1: Apply advanced computing concepts, algorithmic techniques, and programming skills to design efficient software solutions for real-world problems.

PSO2: Analyze, model, and interpret large-scale data using data science, data mining, machine learning, and visualization techniques for informed decision-making.

PSO3: Design and develop Intelligent Systems using Artificial Intelligence, Generative AI, Deep Learning, Natural Language Processing, and Computer Vision technologies.

PSO4: Develop secure computing environments by applying principles of cyber security, cryptography, blockchain technology, digital forensics, and network security.

PSO5: Design, implement, and deploy scalable web, mobile, cloud-based, and distributed applications using modern frameworks, databases, and emerging technologies.

PSO6: Integrate hardware and software concepts to build embedded, IoT-enabled, and automation-based solutions for smart and sustainable applications.

PSO7: Evaluate and optimize computing systems, operating systems, databases, and big data platforms using analytical, research, and problem-solving skills.

PSO8: Demonstrate professional competency, ethical practices, communication skills, teamwork, lifelong learning, and socially responsible innovation in computing domains.

St. Xavier's College (Autonomous)
M.Sc. Computer Science - 2026
(With Effect from June 2026)

Sem	Part	Status	Sub. Code	Title of the Paper	Hrs	Cdt
I	A	Core-1	26PCSC11	Design and Analysis of Algorithms	5	4
		Core-2	26PCSC12	Data Science Techniques	5	4
		Core-3	26PCSC13	Generative AI Programming	5	4
		Core-4	26PCSC14	Generative AI Programming Lab	5	2
	B	EC-1	26PCSE11	Cyber Security and Block Chain Technology/ Digital Forensics	5	4
		EC-2	26PCSE12	Design and Analysis of Algorithms Lab/ Digital Forensics Lab	5	2
					30	20
II	A	Core-5	26PCSC21	Data Mining and Warehousing	6	4
		Core-6	26PCSC22	Advanced Operating Systems	6	5
		Core-7	26PCSC23	Advanced Java Programming	6	5
	B	EC-3	26PCSE21	Theory of Computation/ Natural Language Processing	4	3
		EC-4	26PCSE22	Advanced Java Programming Lab/ Natural Language Processing Using Python	4	3
		SEC1	26PCSS21	Data Mining Lab	4	2
	C	Extension Activities		STAND (Student Training and Action for Neighbourhood Development)	-	1
					30	23
III	A	Core-8	26PCSC31	Web Application Development	6	5
		Core-9	26PCSC32	Web Application Development Lab	6	4
		Core-10	26PCSC33	Robotics Process Automation	6	5
		Core-11	26PCSC34	Big Data Analytics	6	5
	B	EC-5	26PCSE31	Deep Learning/ Network Security and Cryptography	3	3
		SEC2	26PCSS31	Robotics Process Automation Lab	3	2
		Internship	26PCSI35	Internship	-	2
					30	26
	A	Core-12	26PCSC41	Digital Image Processing	6	5
		Core-13	26PCSC42	Digital Image Processing Lab using Python	6	5
		Project	26PCSC43	Project with Viva Voce	10	7
		EC-6	26PCSE41	Internet of Things/ Embedded Systems	4	3

IV	B	SEC3	26PCSS41	Advanced Database Management System/Professional Competency Skill	4	2
					30	22
					120	91
					Additional Compulsory Courses	
					I Year (Value – Added Course)	
					II Year (Extra - Credit Course)	
					MOOC	
					Field Visit	
					120	100

ABBREVIATIONS

- C - Core
- EC -Elective Course
- SEC - Skill Enhancement Course
- I- Internship
- P-Project

LIST OF ELECTIVE COURSES

	SUBJECT CODE	TITLE OF PAPER
Elective I	26PCSE11	Cyber Security and Block Technology
		Digital Forensics
Elective II	26PCSE12	Design and Analysis of Algorithms Lab
		Digital Forensics Lab
Elective III	26PCSE21	Theory of Computation
		Natural Language Processing
Elective IV	26PCSE22	Advanced Java Programming-Lab
		Natural Language Processing Lab
Elective V	26PCSE31	Deep Learning
		Network Security and Cryptography
Elective VI	26PCSE41	Internet of Things
		Embedded Systems

EXTRA CREDIT COURSES

SEM	SUBJECT CODE	TITLE OF PAPER
I	26PCSEC1	Mobile Application Development
II	26PCSEC2	Computer Vision
III	26PCSEC3	Green Computing
IV	26PCSEC4	Business Intelligence

VALUE ADDED COURSES

SUBJECT CODE	TITLE OF PAPER
26PCSVC1	Data Visualisation Tools
26PCSVC2	MERN Stack
26PCSVC3	Quantum Computing

DESIGN AND ANALYSIS OF ALGORITHMS
(26PCSC11)

SEMESTER I CORE-1 HOURS: 5 CREDITS: 4 TOTAL HOURS: 75

COURSE OUTCOMES (CO):

Upon successful completion of this course, students will be able to:

- | | | |
|------------|--|-----------|
| CO1 | Define and categorize different classes of algorithms and analyze basic algorithm complexity using Big-Oh notation. | K2 |
| CO2 | Construct algorithmic solutions using divide and conquer and evaluate their time and space complexity effectively. | K3 |
| CO3 | Apply dynamic programming and greedy strategies to model and solve optimization problems. | K3 |
| CO4 | Design efficient algorithms for graph problems and analyze their correctness and performance using formal proofs. | K4 |
| CO5 | Develop and compare approximate and randomized algorithms for complex NP-hard problems. | K5 |
| CO6 | Critically examine algorithm performance through empirical analysis and synthesize improvements using advanced techniques. | K6 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit I: (15 Hours)

Definition of algorithms – Algorithm Specification – Performance Analysis - Time and space complexity - Amortized analysis - Asymptotic notation: Big-O, Ω , Θ , little-o, little- ω - NP-completeness: P, NP, NP-complete, NP-hard

Unit II: (15 Hours)

Divide and Conquer: The General method - Binary Search - Finding the maximum and minimum - Merge sort - Quick sort

Unit III: (15 Hours)

Greedy Method: The General method – Knapsack problem – Job Sequencing with Deadlines – minimum cost spanning trees (Prim's & Kruskal's) – Single Source Shortest Paths

Unit IV: (15 Hours)

Dynamic Programming: The General Method – Multistage Graphs – All-Pairs Shortest Paths - Optimal Binary Search Tree - 0/1 Knapsack – The Traveling Salesperson Problem - Flow Shop Scheduling

Unit V: (15 Hours)

Back Tracking: The General Method - The 8-Queens Problem - Sum of Subsets - Graph Colouring - Hamiltonian Cycles - **Branch and Bound:** The Method – Traveling Salesperson

Text Book:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, Sartaj Sahni & Sanguthevar Rajasekaran, 2nd Edition, Universities Press (India) Private Limited, 2018 Reprint.

Reference Books:

1. Cormen, Leiserson, Rivest, Stein, Introduction to Algorithms, The MIT Press, 3rd Edition, 2014
2. Kleinberg, Tardos, Algorithm Design, Cornell University, 2005.

WEB REFERENCES:

1. <https://www.geeksforgeeks.org/fundamentals-of-algorithms/>
2. <https://cs161-stanford.github.io/resources/>

DATA SCIENCE TECHNIQUES

(26PCSC12)

SEMESTER I CORE – 2 HOURS - 5 CREDITS- 4 TOTAL HOURS – 75

COURSE OUTCOMES (CO):

Upon successful completion of this course, students will be able to:

- | | | |
|------------|---|-----------|
| CO1 | Explain the basic concepts of Data Science and Big Data. | K2 |
| CO2 | Use probability and basic statistical methods to analyze data. | K3 |
| CO3 | Apply scoring, ranking, and statistical testing methods to interpret data. | K3 |
| CO4 | Design simple data visualizations to explore and understand data. | K4 |
| CO5 | Develop and evaluate basic mathematical and baseline models. | K5 |
| CO6 | Evaluate the effectiveness of regression and classification methods in supervised learning for analyzing data.. | K6 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

UNIT – I (15 hours)

Introduction To Data Science: Definition, Big Data and Data Science Hype, Datafication , Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Big Data Can Mean Big Assumptions, Modelling, Philosophy of Exploratory Data Analysis, The Data Science Process , A Data Scientist's Role in this Process Case Study: Real Direct

UNIT –II (15 hours)

Mathematical Preliminaries: Probability, Descriptive Statistics, Correlation Analysis Data Munging: Properties of Data, Languages for Data Science, Collecting Data, Cleaning Data, Crowdsourcing.

UNIT – III (15 hours)

Scores and Rankings: Developing Scoring Systems, Z-scores and Normalization, Advanced Ranking Techniques Statistical Analysis: Sampling from Distributions, Statistical Distributions, Statistical Significance, Permutation Tests and P-values

UNIT- IV (15 hours)

Visualizing Data: Exploratory Data Analysis, Developing a Visualization Aesthetic, Chart Types, Great Visualizations Mathematical Models: Philosophies of Modeling, A Taxonomy of Models, Baseline Models, Evaluating Models, Evaluation Environment

UNIT-V (15 hours)

Machine Learning: Naive Bayes, Decision Trees Classifiers, Boosting and Ensemble Learning, Support Vector Machines, Degree of Supervision, Deep Learning

TEXT BOOKS:

1. Steven S. Skiena, “The Data Science Design Manual”, Springer 2017. (Unit II, III, IV)
2. Rachel Schutt & O’neil, “Doing Data Science”, Straight Talk from The Frontline O’REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.(Unit I,V)

REFERENCE BOOKS

1. Joel Grus,” Data Science from Scratch” First Edition, April 2015
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani , “An Introduction to Statistical Learning-with Applications in R“, 2013
3. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2 edition (30 September 2014)

WEB REFERENCES:

1. “Data science for engineers” <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs28/>

GENERATIVE AI PROGRAMMING

(26PCSC13)

SEMESTER I CORE - 3 HOURS: 5 CREDITS: 4 TOTAL HOURS: 75

COURSE OUTCOMES (CO):

Upon successful completion of this course, students will be able to:

- | | | |
|------------|---|-----------|
| CO1 | Explain the principles, evolution, and types of generative AI models. | K3 |
| CO2 | Apply Python techniques to preprocess data and build generative applications. | K3 |
| CO3 | Construct prompts and pipelines for effective interactions with AI systems. | K4 |
| CO4 | Demonstrate usage of key generative AI tools and APIs to generate text, images, and code. | K3 |
| CO5 | Analyze model behavior, outputs, risks, and ethical implications of AI systems. | K4 |
| CO6 | Evaluate performance and limitations of generative AI solutions in real-world scenarios. | K4 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit I: (15 Hours)

Fundamentals of Generative AI: History, overview & evolution of AI - AI Paradigms - Generative AI Techniques and Models: Generative Adversarial Networks (GANs) - Variational Autoencoders (VAE) – Probabilistic and Neural Network models - Large Language Models - Applications: text generation, image synthesis, speech, video and code generation, healthcare, finance, education

Unit II: (15 Hours)

Python Programming for Generative AI: Python: data types, control flow, functions - Data preprocessing for text & image data - Libraries: NumPy, Pandas, Matplotlib - APIs for Python AI workflows - Writing Python scripts to interface with generative models (Meta LLaMA, StarCoder2, CodeT5, FLUX)

Unit III: (15 Hours)

Prompt Engineering: Introduction to prompt engineering - Prompt types: zero-shot, one-shot, few-shot, chain-of-thought, instruction, dynamic and multistep prompting - Structured prompts and templates - Prompt evaluation & refinement - Prompt strategies for different modalities (text, code, reasoning) – Challenges of prompting

Unit IV: (15 Hours)

Generative AI Tools and Frameworks: Overview of tools: ChatGPT, Claude, Gemini, and others - OpenAI API, Hugging Face, LangChain - Vector databases & Retrieval Augmented Generation (RAG) - Model pipelines in Python - Evaluation & safety mechanisms

Unit V:**(15 Hours)**

Projects, Ethics & Evaluation Projects, Ethics & Evaluation: Hands-on projects: text generator, chatbot, image synthesis - Deployment basics - Performance metrics & evaluation - Ethical considerations, bias, hallucination, misuse - Limitations and future directions

Text Books:

1. Rajan Gupta, Sanju Tiwari, Poonam Chaudhary, Generative AI: Techniques, Models and Applications, Springer, 2025. (Unit I, V)
2. Bert Gollnick, Generative AI with Python, Rheinwerk Computing, 2025. (Unit II, IV)
3. Nik Bear Brown, Prompt Engineering for Generative AI, Abecedarian, LLC, 2023 (Unit III)

Reference Books:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Springer, 2026.
2. Usman Qamar, Muhammad Summair Raza, Generative AI Foundations and Concepts, Springer, 2026

WEB REFERENCES:

1. <https://ai.google/education/>
2. <https://platform.openai.com/docs/guides/prompt-engineering>
3. <https://ai.meta.com/llama/>

GENERATIVE AI PROGRAMMING LAB

(26PCSC14)

SEMESTER I CORE -4 HOURS: 5 CREDITS: 2 TOTAL HOURS: 75

COURSE OUTCOMES (CO):

Upon successful completion of this course, students will be able to:

- | | | |
|------------|---|-----------|
| CO1 | Apply Python programming fundamentals to preprocess data and implement basic generative AI workflows. | K3 |
| CO2 | Demonstrate the use of generative AI tools and APIs to generate text, code, and educational content. | K3 |
| CO3 | Construct effective prompts using zero-shot, few-shot, and chain-of-thought techniques for varied tasks. | K4 |
| CO4 | Implement Python-based programs that interact with generative AI models for real-world applications, | K3 |
| CO5 | Analyze the outputs of generative AI systems to identify errors, bias, and limitations, | K4 |
| CO6 | Evaluate the performance and usefulness of generative AI solutions through experiments and lab exercises. | K4 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

1. Write a Python program to demonstrate basic data types and control structures (list, dictionary, loop, function).
2. Create a Python script to read a text file and count words, sentences, and characters.
3. Implement a simple text pre-processing program (lowercasing, stop-word removal, tokenization).
4. Use NumPy and Pandas to load a dataset and display basic statistics (mean, count, unique values).
5. Visualize text data using Python (word frequency bar chart using Matplotlib).
6. Compare outputs of a traditional rule-based program and a generative AI tool for text generation (short paragraph).
7. Write a Python program to call a generative AI API and generate a short paragraph from a prompt.
8. Generate multiple text outputs for the same prompt and observe variation.
9. Create a simple FAQ generator using generative AI and Python.
10. Write a program to log prompts and generated outputs into a file for analysis.
11. Design zero-shot prompts for:
 - Definition
 - Explanation
 - Summary
12. Design few-shot prompts to generate:
 - Email replies
 - Student feedback comments
13. Create a chain-of-thought prompt to solve a simple reasoning problem.
14. Refine a prompt iteratively and document how output quality improves.
15. Create prompt templates using Python variables for reusable prompts.

16. Generate Python code using a generative AI tool for a simple problem (factorial, palindrome, sorting).
17. Use a generative AI tool to summarize a long paragraph and compare it with manual summary.
18. Create a chatbot using Python that responds to user input using a GenAI API.
19. Generate educational content (MCQs or short notes) for a given syllabus topic.
20. Analyze AI output for bias, hallucination, or incorrect information and report observations.

CYBER SECURITY AND BLOCKCHAIN TECHNOLOGY
(26PCSE11)

SEMESTER-1 ELECTIVE -T1 HOURS – 5 CREDITS – 4 TOTAL HOURS: 75

Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Explain basics of data communication, networks, and cybersecurity concepts including attacks and security mechanisms.	K2
CO2	Explain classical and modern cryptography including DES, AES, and RSA algorithms.	K2
CO3	Apply cryptographic techniques and key distribution methods to secure data and communication.	K3
CO4	Analyse intrusion detection systems and network security threats.	K4
CO5	Evaluate Blockchain concepts, architecture, and applications in real-world domains.	K5
CO6	Design basic Blockchain-based solutions for secure transactions and data Integrity	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

UNIT I (15 Hours)

Data Communication: Components-Data Representation-Data Flow. Networks: Network Criteria- Physical Structures – Types of Networks: Local Area Network- Wide Area Network- Switching- The Internet- Accessing the Internet-Connecting Devices: Hubs- Link-Layer Switches-Routers. Information and Network Security Concepts - Cybersecurity, Information Security- Network Security- Security Attacks - Security Services- Security Mechanisms- Cryptography.

UNIT II (15 Hours)

Classical Encryption Techniques: Symmetric Cipher Model - Substitution Techniques - Transposition Techniques - The Data Encryption Standard – A DES Example – The Strength of DES – Block Cipher Design Principles. Advanced Encryption Standard: Finite Field Arithmetic– AES Structure – AES Transformation Functions – AES Key Expansion –An AES Example.

UNIT III (15 Hours)

Block Cipher Operation: Multiple Encryption and triple DES -Electronic Codebook-Cipher feedback Mode-Output feedback mode- Counter mode. Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems - Applications for Public-Key Cryptosystems- Requirements for Public-Key Cryptography- Public-Key Cryptanalysis. The RSA Algorithm : Description of the Algorithm-Computational Aspects-The Security of RSA.

UNIT IV

(15 Hours)

Lightweight Cryptography and Post-Quantum Cryptography: Lightweight Cryptography Concepts - Lightweight Cryptographic Algorithms - Post-Quantum Cryptography Concepts - Post-Quantum Cryptographic Algorithms. Wireless Network Security : Wireless Security - Mobile Device Security . Intrusion Detection Systems: Basic principles - Approaches to intrusion detection - Host-based intrusion detection techniques - Network-based intrusion detection systems.

UNIT V

(15 Hours)

Introduction to Blockchain – Public, Private and Hybrid Blockchains - Distributed Ledger Technology (DLT) – Blockchain Architecture – Introduction to Hashing and Consensus, Bitcoin and Merkle Trees — Blockchain Components - Smart Contracts Introduction – Applications of Blockchain in Insurance, Finance, Smart Assets, Healthcare, Electronic Currency and Manufacturing.

Text Books:

1. Behrouz A. Forouzan, “Data Communication and Networking”, Tata Mc Graw Hill, 6th Edition, 2022. (Unit-1)
2. William Stallings, “Cryptography and Network Security – Principles and Practices”, Pearson Education / PHI, 8th Edition, 2023. (Units - 1, 2, 3, 4)
3. Kumar Saurabh, Ashutosh Saxena, “Blockchain Technology: Concepts and Applications”, Wiley India Pvt. Ltd., First Edition 2020. (Unit- 5)

Reference Books:

1. Bernard Menezes, “Network Security and Cryptography”, Cengage, 1st Edition, 2010.
2. Arshdeep Bahga and Vijay Madisetti, “Blockchain Applications: A Hands-On Approach”, VPT Publications, 2021.

Web Reference:

1. <https://www.cigref.fr/wp/wp-content/uploads/2019/02/Cigref-Blockchain-from-theory-to-practice-Transformational-challenges-in-adopting-blockchain-2018-October-EN.pdf>
2. <https://www.geeksforgeeks.org/ethical-hacking/blockchain-technology-introduction/>
3. <https://www.viirj.org/specialissues/2025/SP2502/2.pdf> - Reference for IKS

DIGITAL FORENSICS (26PCSE11)

SEMESTER -1 ELECTIVE – 1 HOURS – 5 CREDITS – 4 TOTAL HOURS: 75

Course Outcomes:

Upon Completion of the course, the students will be able to

CO1	Explain the principles and scope of digital forensics	K2
CO2	Identify types of cybercrimes and digital evidence	K3
CO3	Perform forensic acquisition and analysis of storage devices	K3
CO4	Apply network and memory forensic techniques	K4
CO5	Investigate mobile and cloud-based crimes	K4
CO6	Prepare forensic reports and present findings ethically	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

UNIT – 1 (15 Hours)

Digital Forensics: Definition, History, and Importance - Types of Cybercrimes - Locard's Exchange Principle - Digital Evidence: Types and Characteristics - Forensic Investigation Process - Chain of Custody - Roles of Digital Forensic Investigator.

UNIT – 2 (15 Hours)

Storage Media and Data Representation - File Systems: FAT, NTFS, EXT - Disk Partitions and Boot Records - Deleted File Recovery - File Carving Techniques - Metadata and Timestamp Analysis - Disk Imaging and Hashing (MD5, SHA-1, SHA-256).

UNIT – 3 (15 Hours)

Windows and Linux Forensics Overview - Registry Analysis - Log File Examination - Memory Acquisition - Volatile vs Non-Volatile Data - Malware Forensics Basics - Process and Thread Analysis.

UNIT – 4 (15 Hours)

Network Forensics Concepts - Packet Capture and Traffic Analysis - Email Forensics - Web Browser Forensics - IP Address Tracing - Intrusion Detection Logs - Social Media Forensics.

UNIT – 5 (15 Hours)

Mobile Device Forensics - SIM and SD Card Analysis - Android and iOS Forensics - Cloud Forensics Challenges - Digital Forensic Laws and Regulations - Cyber Laws in India - Ethics and Professional Conduct.

Text Books:

1. Casey, E. (2011). Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet (3rd ed.). Academic Press, Elsevier. ISBN: 978-0123742681. **(Unit – 1, 2)**
2. Nelson, B., Phillips, A., & Steuart, C. (2019). Guide to Computer Forensics and Investigations (6th ed.). Cengage Learning. ISBN: 978-1337568944. **(Unit – 3,4)**
3. Prorise, C., & Mandia, K. (2003). Incident Response & Computer Forensics (2nd ed.). McGraw-Hill/Osborne. ISBN: 978-0072226966. **(Unit - 5)**

Reference Books:

1. Carrier, B. (2005). File System Forensic Analysis. Addison-Wesley Professional. ISBN 978-0321268174.
2. Carvey, H. (2012). Windows Forensic Analysis Toolkit: Advanced Analysis Techniques for Windows 7 (3rd ed.). Syngress/Elsevier. ISBN 978-1597497275.
3. Belapure, S., & Godbole, N. (2011). Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives. Wiley India. ISBN 978-8126521791.

Web references:

1. https://alison.com/course/digital-forensics-examiner?utm_source=chatgpt.com
2. https://www.mygreatlearning.com/academy/learn-for-free/courses/cyber-forensics?utm_source=chatgpt.com
3. https://www.coursera.org/learn/digital-forensics-concepts?utm_source=chatgpt.com
4. https://academy.cyber5w.com/courses/C5W-100?utm_source=chatgpt.com P
5. https://wizape.com/English/Digital-ForensicsFundamentals?utm_source=chatgpt.com
6. https://www.mindluster.com/certificate/9968/Digital-Forensics-Tools-video?utm_source=chatgpt.com

**DESIGN AND ANALYSIS OF ALGORITHMS LAB
(26PCSE12)**

SEMESTER I ELECTIVE-2 HOURS: 5 CREDITS: 2 TOTAL HOURS: 75

COURSE OUTCOMES (CO):

Upon successful completion of this course, students will be able to:

- | | | |
|------------|---|-----------|
| CO1 | Implement divide-and-conquer algorithms such as Binary Search, Merge Sort, Quick Sort, and Max–Min, and determine their time and space complexity. | K3 |
| CO2 | Apply greedy strategies to construct solutions for optimization problems including Knapsack, Job Sequencing with Deadlines, Prim’s, Kruskal’s, and Dijkstra’s algorithms. | K3 |
| CO3 | Apply dynamic programming techniques to solve complex problems such as All-Pairs Shortest Paths (Floyd–Warshall) and the Traveling Salesman Problem. | K3 |
| CO4 | Analyze graph-based algorithms for correctness and efficiency, including Minimum Spanning Tree and Shortest Path algorithms. | K4 |
| CO5 | Design backtracking solutions for combinatorial problems such as 8-Queens, Sum of Subsets, Graph Coloring, and Hamiltonian Cycle. | K5 |
| CO6 | Evaluate and compare multiple algorithmic approaches to determine their suitability and performance for various computational problems. | K5 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

1. Binary Search (Recursive & Iterative)
2. Find Maximum and Minimum using Divide & Conquer
3. Merge Sort
4. Quick Sort
5. Knapsack Problem
6. Job Sequencing with Deadlines
7. Prim’s Algorithm
8. Kruskal’s Algorithm
9. Dijkstra’s Single Source Shortest Path Algorithm
10. All-Pairs Shortest Paths (Floyd-Warshall) Algorithm
11. 8-Queens Problem
12. Sum of Subsets
13. Graph Coloring
14. Hamiltonian Cycle
15. Traveling Salesman Problem

DIGITAL FORENSICS LAB

(26PCSE12)

SEMESTER – I ELECTIVE – 2 HOURS – 5 CREDITS – 2 TOTAL HOURS-75

Course Outcomes:

Upon completion of the course, the students will be able to:

- | | | |
|------------|---|-----------|
| CO1 | Apply fundamental principles of digital forensics to acquire, preserve, and document digital evidence using standard forensic procedures. | K3 |
| CO2 | Create and verify forensic disk images and validate evidence integrity using cryptographic hashing techniques. | K3 |
| CO3 | Analyse file systems and storage media to recover deleted files and interpret metadata for investigative purposes. | K3 |
| CO4 | Perform memory, network, email, mobile, and browser artifact analysis using open-source forensic tools. | K4 |
| CO5 | Interpret forensic findings to identify suspicious activities, intrusions, and malicious behaviour in digital systems. | K4 |
| CO6 | Prepare and present professional forensic investigation reports following legal and ethical standards. | K4 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

List of Practical's:

1. Creating forensic disk images.
2. Calculating and verifying hash values.
3. Recovering deleted files.
4. File system analysis.
5. Memory dump analysis.
6. Network packet capture and inspection
7. Email header analysis.
8. Mobile data extraction.
9. Browser artifact examination
10. Preparing forensic investigation report.

**DATA MINING AND WAREHOUSING
(26PCSC21)**

SEMESTER-II CORE-5 HOURS-6 CREDITS-4 TOTAL HOURS: 90

Course Outcomes:

Upon completion of the course, the students will be able to

- | | | |
|------------|---|-----------|
| CO1 | Describe the basic concepts of data mining, data types, tasks, and preprocessing techniques | K2 |
| CO2 | Apply data preprocessing methods and similarity measures for data preparation. | K3 |
| CO3 | Analyze classification techniques such as decision trees, Bayesian classifiers, and neural networks | K4 |
| CO4 | Analyze clustering and association rule mining techniques for pattern discovery | K4 |
| CO5 | Evaluate outlier detection methods and data mining applications in real-world domains. | K5 |
| CO6 | Design data warehousing architectures, OLAP models, and schemas for decision support systems | K6 |

UNIT I: (18 Hours)

Introduction and Data Preprocessing: What is Data Mining? – Motivating Challenges – Origins of Data Mining – Data Mining Tasks – Types of Data – Attributes and Measurement – Types of Data Sets – Data Quality – Measurement and Data Collection Issues – Issues Related to Applications – Data Preprocessing – Aggregation – Sampling – Dimensionality Reduction – Feature Subset Selection – Feature Creation – Discretization and Binarization – Variable Transformation – Measures of Similarity and Dissimilarity – Similarity and Dissimilarity between Data Objects.

UNIT II: (18 Hours)

Classification Techniques: Basic Concepts – General Approach to Solving a Classification Problem – Decision Tree Induction – How a Decision Tree Works – How to Build a Decision Tree – Measures for Selecting the Best Split – Model Evaluation – Overfitting and Underfitting – Holdout Method – Random Subsampling – Cross Validation – Bootstrap – Rule-Based Classification – Nearest Neighbor Classifiers – Bayesian Classification – Bayes Theorem – Naïve Bayes Classifier – Artificial Neural Networks – Perceptron – Multilayer Neural Network – Characteristics of ANN.

UNIT III: (18 Hours)

Clustering and Association Analysis: Cluster Analysis – Types of Clustering – K-Means Clustering – Algorithm – Strengths and Weaknesses – Hierarchical Clustering – Agglomerative and Divisive Methods – Density-Based Clustering – DBSCAN Algorithm – Cluster Evaluation. Association Analysis: Basic Concepts – Frequent Itemset Generation – Apriori Principle –

Candidate Generation and Pruning – Support Counting – Rule Generation – FP-Growth Algorithm.

UNIT IV:

(18 Hours)

Outlier Detection and Data Mining Applications: Outlier Detection – Definition and Importance – Types of Outliers – Statistical Approaches – Distance-Based Outlier Detection – Density-Based Methods – Clustering-Based Outlier Detection – Applications of Outlier Detection. Data Mining Applications – Market Basket Analysis – Fraud Detection – Intrusion Detection – Recommendation Systems – Healthcare Applications – Web Mining – Social Network Analysis – Text and Multimedia Data Mining.

UNIT V:

(18 Hours)

Data Ware Housing: introduction-characteristics of a data ware house–data marts–other aspects of data Mart. Online Analytical Processing: Introduction –OLTP & OLAP systems. Data modeling –star schema for multidimensional view –Data modeling – multi-fact star schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet. Lakehouse Architecture: Introduction to Data Lakehouse – Difference between Data Warehouse, Data Lake and Lakehouse – Benefits of Lakehouse Architecture – Medallion Architecture (Bronze, Silver, Gold Layers) – Delta Lake Concepts – Unified Analytics and AI – Real-Time Data Processing – Lakehouse Governance and Data Management – Applications of Lakehouse in Modern Enterprises.

Text books:

1. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, “Introduction to Data Mining”, 2nd Edition, Pearson Education, 2019.(Unit I,II,III & IV)
2. C.S.R. Prabhu, “Data Warehousing Concepts, Techniques, Products and Applications”, PHI, Second Edition, 2008. (Unit V)
3. BillInmon, Mary Levins, Ranjeet Srivastava, “Building the Data Lakehouse”, Wiley Publications, 2021. (Unit V)

Reference Books:

1. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining: Concepts and Techniques”, 3rd Edition, Morgan Kaufmann / Elsevier.
2. Ralph Kimball, Margy Ross, “The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling”, 3rd Edition, Wiley.
3. Alex Berson, Stephen J. Smith, “Data Warehousing, Data Mining, and OLAP”, McGraw-Hill.

Official Website References:

1. [Databricks Official Website](#)
2. [Databricks Lakehouse Documentation](#)
3. [Well-Architected Lakehouse Framework](#)
4. [Lakehouse Architecture Overview](#)

**ADVANCED OPERATING SYSTEMS
(26PCSC22)**

SEMESTER-II CORE-6 HOURS-6 CREDITS-5 TOTAL HOURS: 90
Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Recall the fundamental concepts of operating systems including process scheduling, deadlocks, and distributed systems.	K1
CO2	Explain the design issues and working principles of distributed and real-time operating systems.	K2
CO3	Apply process management techniques such as scheduling algorithms, deadlock handling methods, and distributed file system concepts.	K3
CO4	Analyze real-time task scheduling and compare operating system architectures such as Linux and iOS.	K4
CO5	Evaluate different operating systems for their performance and security.	K5
CO6	Design a customized process scheduling method.	K6

UNIT I **(18 Hours)**

Basics of Operating Systems: What is an Operating System? – Types of Operating System-Feature Migration – Computing Environments. Process Scheduling –Inter Process Communication- Deadlocks– Prevention – Avoidance – Detection – Recovery.

UNIT II **(18 Hours)**

Distributed Operating Systems: Issues – Communication Primitives – Lamport’s Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems – design issues – Case studies – The Sun Network File System-Coda.

UNIT III **(18 Hours)**

Real time Operating Systems : Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling

UNIT IV **(18 Hours)**

Operating Systems for Handheld Systems: Requirements–Technology Overview–Handheld Operating Systems–Palm OS-Symbian Operating System-Android–Architecture of android–systems. iOS – iOS Architecture- Cross platform Framework- Securing handheld

UNIT V **(18 Hours)**

Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “Operating System Concepts”, Tenth Edition, John Wiley & Sons, 2018 (Unit I).
2. Mukesh Singhal and Niranjana G. Shivaratri, “Advanced Concepts in Operating Systems –Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2017.(Unit II)
3. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2015 (Unit III).

Reference Books:

1. Pramod Chandra P.Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010
2. Daniel.P.Bovet & Marco Cesati, “Understanding the Linux kernel”, 3rd edition, O’Reilly, 2005 (Unit V)
3. Christian Keur & Aaron Hillegass “iOS Programming: The Big Nerd Ranch Guide”, 6th Edition, 2017 (Unit V)

Web Resources

1. <https://nptel.ac.in/courses/106105214>
2. https://flutterjunction.com/notes/android-application-development/introduction-to-mobile-oses?utm_source
3. https://mas.owasp.org/MASTG/0x05a-Platform-Overview/?utm_source
4. https://gangw.cs.illinois.edu/class/cs463/463.11.1-Smartphone.pdf?utm_source

ADVANCED JAVA PROGRAMMING

(26PCSC23)

SEMESTER-II

Core-7

HOURS-6

CREDITS-5 TOTAL HOURS:90

Course Outcomes:

Upon completion of the course, the students will be able to

- CO1:** Define and interpret a java program with event classes, multithreading and socket networking. **K2**
- CO2:** Illustrate the architecture of MVC to develop an application using RMI. **K3**
- CO3:** Select Swing components to program a window-based applications with event handling mechanism. **K3**
- CO4:** Categorize the J2EE components that ensure the reliable server-side web applications. **K4**
- CO5:** Apply the Java program that access a database by means of Java Database Connectivity. **K5**
- CO6:** Integrate J2EE API to develop a console applications and web applications. **K6**

UNIT I

(18 Hours)

Networking: Networking Basics - The Networking Classes and Interfaces – InetAddress - TCP/IP Client Sockets - URL - URLConnection – HttpURLConnection - TCP/IP Server Sockets - Datagrams. **Introducing the AWT:** AWT Classes - Window Fundamentals - Introducing Swing - Exploring Swing - **Event Handling.**

UNIT II

(18 Hours)

Java Beans: What is Java Bean – Advantages of Java Bean – Introspection – Persistence - The Java Beans API. **Understanding Remote Method Invocation:** Providing an Overview of RMI - Developing Applications with RMI - Pushing Data from the RMI Server.

UNIT III

(18 Hours)

Understanding Java and the J2EE platform: Examining the origin of J2EE API's – Working with the Model -View-Controller. **Studying Servlet Programming:** Creating application using Servlets – Using the Servlet Context – Performing URL redirection – Using sendRedirect() - Session tracking with servlets – Cookies – URL rewriting – Hidden fields – Session tracking API with HttpSession Object –Login Servlet example – Listeners –Deploying servlets - The Web-application archive – Examining the web.xml deployment descriptor.

UNIT IV

(18 Hours)

JSP Basics – The JSP Engine - Multithreading and persistence - the JSP cycle – Sending Information- Setting Cookies- Tracking Sessions: Tracking data between request. **JSP scripting elements and Directives:** Declarations – Expressions – Directives – Scriptlets – Comments – Actions – Implicit JSP Objects – Error Pages - Using Java Beans.

UNIT V

(18 Hours)

Reviewing Java Database Connectivity: Introducing JDBC Driver types – Creating first JDBC program – Retrieving data – Database-error processing – Processing result sets – ResultSet MetaData class – Scrollable result set – PreparedStatement class – CallableStatement class – Performing batch updates – Using savepoints – Using RowSet interface.

Text Books:

1. Herbert Schildt , “ JAVA 2: The Complete Reference”, Oracle press, Eighth Edition, 2017. (Units I, II)
2. James McGovern, Rahim Adatia et al, “J2EE 1.4 Bible”, Wiley, 2003. (Units II, III, IV, V)
3. Damon, Hougland, Aaron Tavistock, “Core JSP”, Prentice Hall, 2000. (Unit IV)

Reference Books:

1. Jim Keogh, “The Complete Reference J2EE”, Tata Mc Graw Hill Publishing Company Ltd, 2010.
2. Deitel and Deitel, “Java How to Program”, Third Edition, PHI Pearson Education Asia, 2014.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2. <https://www.javatpoint.com/servlet-tutorial>
3. <https://www.tutorialspoint.com/java/index.html>

THEORY OF COMPUTATION
26PCSE21

SEMESTER II HOURS-4 CREDITS-3 TOTAL HOURS-60

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

- | | | |
|-------------|---|-----------|
| CO 1 | Explain key concepts of automata, formal languages, grammars, and computation models. | K2 |
| CO 2 | Interpret relationships among language classes and their corresponding automata. | K2 |
| CO 3 | Apply automata, grammars, and computational models to solve language and decision problems. | K3 |
| CO 4 | Analyse grammatical derivations, automata behaviour, and language hierarchies. | K4 |
| CO 5 | Evaluate computational models for decidability and computational complexity. | K5 |
| CO 6 | Integrate theory of computation concepts to analyse applications and complexity classes. | K6 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit I: (12 Hours)

Introduction to Theory of Computation – motivation, scope, and importance of computation theory – relationship among automata, languages, and computation – alphabets, strings, and languages – operations on languages – classification of languages. Finite automata – definition and components – deterministic finite automata (DFA) – non-deterministic finite automata (NFA) – representation of DFA and NFA – equivalence of DFA and NFA.

Unit II: (12 Hours)

Regular languages – definition and examples – regular expressions – syntax, precedence, and examples – construction of finite automata from regular expressions – conversion of NFA to DFA – minimization of deterministic finite automata – closure properties of regular languages – decision properties of regular languages – regular grammars and their relationship with finite automata – applications of regular languages in lexical analysis, pattern matching, and text processing.

Unit III: (12 Hours)

Context-free grammars (CFG) – definition, notation, and examples – grammar rules and language generation – derivations in context-free grammars – leftmost derivation and rightmost derivation – parse trees and their construction – ambiguity in context-free grammars – normal forms – Chomsky Normal Form and Greibach Normal Form. Pushdown automata (PDA) – definition and operation – equivalence between context-free grammars and pushdown automata – closure and decision properties of context-free languages – applications of context-free languages in syntax analysis and compiler design.

Unit IV:**(12 Hours)**

Context-sensitive grammars – definition and examples – context-sensitive languages – Chomsky hierarchy – linear bounded automata (LBA) – definition and working principle – relationship between context-sensitive grammars and linear bounded automata – properties and limitations of context-sensitive languages – applications of context-sensitive languages.

Unit V:**(12 Hours)**

Turing machines – definition and basic model – language acceptance by Turing machines – variants of Turing machines – universal Turing machine – decidability and undecidability – recursive and recursively enumerable languages – Applications of theory of computation in compiler design, operating systems, artificial intelligence, and network security – Introduction to computational complexity – complexity classes P and NP.

Text Books

1. Peter Linz, Introduction to Formal Languages and Automata, 6th Edition, Jones & Bartlett Learning, 2016. **(Units 1,2 & 3: Chapters 1–5)**
2. S. R. Jena and S. K. Swain, Theory of Computation and Applications (Automata, Formal Languages and Computational Complexity), 2nd Revised Edition, University Science Press / Laxmi Publications, 2020. **(Units 4 & 5: Chapters 5–7)**

Reference Books

1. Michael Sipser, Introduction to the Theory of Computation, 3rd Edition, Cengage Learning, 2013.
2. Alberto Pettorossi, Automata Theory and Formal Languages: Fundamental Notions, Theorems, and Techniques, Springer Cham, 2022.

Web References

1. <https://www.geeksforgeeks.org/theory-of-computation-toc>
2. <https://nptel.ac.in/courses/106/104/106104028>
3. https://www.tutorialspoint.com/automata_theory
4. <https://ocw.mit.edu/courses/automata-computability-and-complexity>

NATURAL LANGUAGE PROCESSING

(26PCSE21)

SEMESTER-II ELECTIVE-3 HOURS-4 CREDITS-3 TOTAL HOURS: 60

Course Outcomes:

Upon completion of the course, the students will be able to

- | | | |
|------------|--|-----------|
| CO1 | Remember fundamental concepts and techniques of NLP. | K1 |
| CO2 | Differentiate NLP techniques based on assumptions, strengths, and weaknesses. | K2 |
| CO3 | Apply NLP methods to analyze text sentiment. | K3 |
| CO4 | Analyze large-scale text data from real-world applications. | K4 |
| CO5 | Evaluate and develop robotic process automation for business efficiency. | K5 |
| CO6 | Design NLP applications such as machine translation and information retrieval. | K6 |

UNIT I (12 Hours)

Introduction : Natural Language Processing tasks in syntax, semantics, and pragmatics – Issue-Applications – The role of machine learning – Probability Basics –Information theory – Collocations - N-gram Language Models – Estimating parameters and smoothing – Evaluating language models.

UNIT II (12 Hours)

Word level and Syntactic Analysis: Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. **Syntactic Analysis:** Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

UNIT III (12 Hours)

Semantic analysis and Discourse Processing: Nyaya logical system- Semantic Analysis-Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing-cohesion-Reference Resolution- Discourse Coherence and Structure.

UNIT IV (12 Hours)

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation- Problems in Machine Translation. **Characteristics of Indian Languages-** Paninian Grammar Framework- Machine Translation Approaches-Translation involving Indian Languages

UNIT V

(12 Hours)

Information retrieval and lexical resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: WorldNet-Frame NetStemmers- POS Tagger- Research Corpora SSAS.

Text Books:

- 1 Daniel Jurafsky, James H. Martin, “Speech & language processing”, Pearson publications, 3rd Edition, 2025. (UNIT –I, II, IV V)
2. Jacob Eisenstein, “Introduction to Language Processing”, 1st Edition, MIT press, 2019. (UNIT –IV)
3. *Satischandra Chatterjee,” Nyaya Theory of Knowledge: A Critical Study of Some Problems of Logic and Metaphysics”, University of Calcutta, Reprint 2020 (Original 1939) (UNIT –III, IV)

Reference Books:

1. Pierre M. Nugues, —An Introduction to Language Processing with Perl and Prolog, Springer
2. *Avadhesh k. singh kapil kapoor ,”Indian Knowledge system,- vol 1 & 2 “, Shimla : Indian Institute of Advanced Study ; New Delhi : D.K. Printworld, Reprint 2005
3. *Aashish P. Jajoo & Shilpa A. Jajoo “Indian Knowledge System (Iks) in Artificial Intelligence, Robotics, and Indigenous Computing: A Interdisciplinary Approach “Vidyabharati International Interdisciplinary Research Journal “, ISSN 2319-4979, April 20225

Web Resources:

1. <https://nptel.ac.in/courses/106105158>
2. https://en.wikipedia.org/wiki/Natural_language_processing
3. <http://www.techtarget.com/searchenterpriseai/definition/natural-language-processing-NLP>

ADVANCED JAVA PROGRAMMING LAB
(26PCSE22)

SEMESTER-II ELECTIVE -4 HOURS-4 CREDITS-3 TOTAL HOURS:60

Course Outcomes:

Upon completion of the course, the students will be able to

- | | |
|--|-----------|
| CO1: Recall basic concepts, terminology, and components of Java networking. | K1 |
| CO2: Associate Swing component with Event handling mechanism. | K2 |
| CO3: Implement the service of Client Server based applications using RMI concepts. | K3 |
| CO4: Categorize interactive web-based applications using servlets and JSP. | K4 |
| CO5: Select data access approaches (Servlet JDBC vs JSP JDBC) for suitability in real-time web applications | K5 |
| CO6: Design and develop complete Java-based web applications integrating networking, Servlets, JSP, JavaBeans | K6 |

LIST OF PROGRAMS:

1. Program to send a text message to another system and receive the text message from the system (use socket programming).
2. Design a calculator using SWING Class.
3. Write a program to build a simple Client Server application using RMI.
4. Simple Servlet Program using GenericServlet.
5. Program for Login Page using HttpServlet.
6. Program to implement Hidden field direction.
7. Program to implement Session tracking in Servlet.
8. Program to implement Cookies in Servlet.
9. Program for JDBC to insert, update and delete records to and from database using Servlet.
10. Program to display employee details in tabular format using Servlet JSP.
11. Program using Scriptlets of JSP.
12. Program using control flow statement in JSP.
13. Program to implement Session tracking on JSP.
14. Program to implement Cookie in JSP.
15. Program to implement implicit object (error page) in JSP.
16. JSP interact with Bean object.
17. Program for JDBC to insert, update and delete records to and from database using JSP.

NATURAL LANGUAGE PROCESSING USING PYTHON
(26PCSE22)

SEMESTER-II CORE- HOURS-4 CREDITS-3 TOTAL HOURS: 75

Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Implement LSI and Named Entity Recognition models	K3
CO2	Apply TF-IDF and Ngram models for text representation	K3
CO3	Develop a Part-of-Speech tagger	K6
CO4	Classify text using POS tagging	K4
CO5	Evaluate NLP applications such as sentiment analysis, spam filtering, and fake news detection	K5
CO6	Create end-to-end NLP solutions integrating preprocessing and classification	K6

LIST OF PRACTICALS

- 1 Write a python program to perform tokenization by word and sentence using nltk.
- 2 Write a python program to eliminate stopwords using nltk.
- 3 Write a python program to perform stemming using nltk.
- 4 Write a python program to perform Parts of Speech tagging using nltk.
- 5 Write a python program to perform lemmatization using nltk.
- 6 Write a python program for chunking using nltk.
- 7 Write a python program to perform Named Entity Recognition using nltk.
- 8 Write the python code to perform sentiment analysis using NLP
- 9 Write the python code to develop Spam Filter using NLP
- 10 Write the python code to detect Fake News using NLP

DATA MINING LAB
(26PCSS21)

SEMESTER–II SEC1 HOURS–4 CREDITS–2 TOTAL HOURS: 60

Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Describe the basic concepts of data mining, data types, tasks using MATLAB.	K2
CO2	Apply data preprocessing methods for preparing datasets using MATLAB.	K3
CO3	Analyze classification techniques using MATLAB.	K4
CO4	Analyze clustering and association rule mining in datasets using MATLAB.	K4
CO5	Evaluate outlier detection techniques and interpret data mining results for real-world datasets using MATLAB.	K5
CO6	Design data mining models and analytical solutions using MATLAB.	K6

1. Implement Apriori algorithm to extract association rules in data mining.
2. Implement K-Means clustering technique.
3. Implement any one Hierarchical Clustering technique (Agglomerative or Divisive).
4. Implement a Classification algorithm.
5. Implement Decision Tree algorithm.
6. Implement Linear Regression.
7. Implement Data Visualization techniques.
8. Implement FP-Growth algorithm for frequent pattern mining.
9. Implement DBSCAN clustering algorithm.
10. Implement k-Nearest Neighbor (k-NN) classification algorithm.
11. Implement Logistic Regression for binary classification.
12. Implement Outlier Detection technique.

WEB APPLICATION DEVELOPMENT

(26PCSC31)

SEMESTER–III Core-8 HOURS–6 CREDITS-5 TOTAL HOURS:90

Course Outcomes:

Upon completion of the course, the students will be able to

- CO1:** Identify the fundamental concepts of web technologies, including HTML, CSS and BOOTSTRAP for responsive and user-friendly web development **K1**
- CO2:** Illustrate JavaScript-based technologies with AJAX and evaluate their roles in web application development **K3**
- CO3:** Apply Node.js concepts to develop basic server-side applications using features of Node.js, including REPL usage. **K3**
- CO4:** Examine the web applications framework by implementing server setup, routing, route parameters and request–response handling. **K4**
- CO5:** Test the custom modules to handle server requests, file operations, and event-driven programming. **K5**
- CO6:** Integrate all components to design, deploy, and present a full-stack web application project using Bootstrap, JavaScript, Node.JS and Express.JS **K6**

UNIT I

(18 Hours)

Bootstrap: Introduction - Basic Example - Container - Jumbotron - Button - Grid - Table - Form - Alert - Wells - Badge - Panels - Image - Glyphicon - Carousel - List Group - Dropdown - Collapse - Tabs - Navbar - Input types - Modals – Popover

UNIT II

(18 Hours)

JavaScript: Introduction to Scripting: Basic Example - Control Statements – Loops – Functions: Program Modules in JavaScript – Function Definition – JavaScript Global Function - Array - Objects – Document Object Model (DOM): Objects and Collections – Java Script Event Handling – Ajax Web Applications – Ajax Example Using the XMLHttpRequest Object – Creating a Full-Scale Ajax-Enabled Application.

UNIT III

(18 Hours)

Introduction: Features and advantages of Node JS, Traditional Web Server Model, Node.js Process Model, Asynchronous programming with Node.js, Types of applications that can be developed using Node.js. Setup Development Environment: Install Node.js on Windows, working in REPL, Node JS Console, creating a Node File with JavaScript, accessing a Node.js File Through the Command Line Interface, Using Node.js in Net-Beans IDE. Other Javascript-Based Technologies: Node.js vs JavaScript, Node.js vs AJAX, Node.js vs JQuery, Node.js vs Angular JS.

UNIT IV**(18 Hours)**

Modules in Node.JS: Modules- Using Modules in a Node.js File - Using the Built-in HTTP Module - Reading the Query String from an HTTP Request- Using the Built - in HTTPS Module - Using the Built-in URL Module - Splitting the Query String from an HTTP Request - Creating a Custom Module. File System Module: Read File – Create Files - Open Files -Write Files -File System Module with URL More on Modules: Module. Util Module - Path Module -OS Module - Readline Module -Stream Module -Buffer Module - Nodemailer Module.

UNIT V**(18 Hours)**

NPM in Node.js: Introduction to NPM, the package.json file, Work with Module /Packages – Publish a module and install from NPM. Event Handling in Node.js: Events in Node.js - Normal Working of a Node.js Application - Methods and Events of EventEmitter Class - Passing arguments and ‘this’ to listeners - Asynchronous vs. Synchronous Call - Handle Events Only Once- Error Events – Other Properties and Methods - Patterns for EventEmitters. Express and Node JS: Introduction to Express Framework- Express Server Request – Response – Routes - Route Parameters - Multiple Route Callback/Handler Functions.

Text Books:

1. Matt Lambert, "Learning Bootstrap 4", Packt Publishing, Second Edition, 2016. (Unit I)
2. Paul Deital, Harvey Deitel & Abbey Deitel,"Internet and World Wide Web - How to Program", Pearson, Fifth Edition, 2012. (Unit II)
3. Dhruti Shah, “Node.JS Guidebook”, BPB Publications, 2018. (Units III, IV, V)

Reference Book:

Basarat Ali Syed, Beginning Node.js, A press, 2014,

Web Resources:

1. <https://www.geeksforgeeks.org/bootstrap/>
2. <https://javascript.info/>
3. <https://nodejs.org/docs/latest/api/>

WEB APPLICATION DEVELOPMENT LAB

(26PCSC32)

SEMESTER–III Core-9 HOURS–6 CREDITS-4 TOTAL HOURS:90

Course Outcomes:

Upon completion of the course, the students will be able to

- | | | |
|-------------|--|-----------|
| CO1: | Recall the concepts of web application development. | K1 |
| CO2: | Associate JavaScript as a dynamic webpage creating tool. | K2 |
| CO3: | Apply Bootstrap components and JavaScript concepts to design responsive web pages. | K3 |
| CO4: | Analyze client-side validation techniques and asynchronous operations (AJAX) to enhance dynamic web application functionality. | K4 |
| CO5: | Evaluate different Node.js modules and server-side techniques to handle routing, file systems, streams and events. | K5 |
| CO6: | Design and develop full-stack web applications using Node.js by integrating custom modules, form handling, routing, and system-level operations. | K6 |

LIST OF PROGRAMS:

BOOTSTRAP

1. Containers and grid
2. Table
3. Alert, Badge and models
4. Collapse and Tabs
5. Form Validation

JAVASCRIPT

6. Form validation
7. Form Validation with CSS
8. Arithmetic Calculation
9. Arithmetic Calculation with AJAX

Node.JS

10. Create a simple Node.js program to display system information.
11. Demonstrate synchronous and asynchronous file reading.
12. Create HTTP server with multiple routes.
13. Create and use custom calculator module.
14. Create custom event using EventEmitter.
15. Read file using stream.
16. Install and check Nodemailer package.
17. Create Express server with GET route.
18. Accept user input from form.

ROBOTICS PROCESS AUTOMATION (26PCSC33)

SEMESTER – III CORE-10 HOURS – 6 CREDITS – 5 TOTAL HOURS – 90

Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Demonstrate the benefits and ethics of RPA	K2
CO2	Understand the Automation cycle and its techniques	K2
CO3	Draw inferences and information processing of RPA	K4
CO4	Implement and apply RPA in Business Scenarios	K5
CO5	Analyse on Robots & leveraging automation	K6
CO6	Create bots for various domains	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

UNIT I (18 Hours)

Scope and automation techniques, Robotic process automation - What can RPA do? Benefits of RPA, Components of RPA, RPA platforms, The future of automation. RPA BASICS: History of Automation - What is RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA – What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture.

UNIT II (18 Hours)

Introduction to RPA Tool - The User Interface - Variables - Managing Variables - Naming Best Practices – The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables – Array Variables - Date and Time Variables - Data Table Variables – Managing Arguments - Naming Best Practices – The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow -Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts – About Control Flow – Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity – The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation-Data Manipulation Introduction - Scalar variables, collections and Tables - Text Manipulation – Data Manipulation.

UNIT III (18 Hours)

Recording Introduction - Basic and Desktop Recording - Web Recording – Input / Output Methods - Screen Scraping - Data Scraping - Scraping Advanced Techniques - Selectors - Defining and Assessing Selectors - Customization -Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation Tables & PDF - Data Tables in RPA - Excel and Data Table basics - Data Manipulation in excel.

UNIT IV

(18 Hours)

What are assistant bots? - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger -Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event-Deploying and maintaining the bot.

UNIT V

(18 Hours)

Introduction to Intelligent Automation – RPA vs Intelligent Automation – AI and Machine Learning in RPA – OCR and Computer Vision in Automation – Natural Language Processing for RPA – Chatbots and Virtual Assistants – Process Mining – Task Mining – Using AI Services with RPA – Hyperautomation – Use Cases of Cognitive Automation – Future Trends in RPA and Intelligent Automation.

Text Books:

1. Alok Mani Tripathi, “Learning Robotic Process Automation”, Packt Publishing, 2018. **(Unit - 1)**
2. Pascal Bornet, “The Simple Implementation Guide to Robotic Process Automation (Rpa): How to Best Implement Rpa in an Organization”, Kindle Edition,2018. **(Unit – 2,3,4)**
3. Lahiru Fernando, “Intelligent Document Processing : A Guide For Building RPA Solutions”, Kindle Edition,2023. **(Unit - 5)**

Reference Books:

1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation,1st Edition 2015.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, Independently Published, 1st Edition 2018.
3. Srikanth Merianda,”Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”, Consulting Opportunity Holdings LLC, 1st Edition 2018.
4. Lim Mei Ying, “Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes”, Packt Publishing, 1st Edition 2018.

Web Resources:

1. <https://www.uipath.com/learning/video-tutorials>
2. https://www.youtube.com/watch?v=kVtgA_PQ5R4
3. https://onlinecourses.nptel.ac.in/noc19_me74/preview

BIG DATA ANALYTICS

(26PCSC34)

SEMESTER-III CORE -11 HOURS -6 CREDITS - 5 TOTAL HOURS: 90

Course Outcomes:

Upon completion of the course, the students will be able to

- CO1** Explain the concepts of Big Data, its characteristics, data types, architecture, and applications in different domains. **K2**
- CO2** Describe the architecture and working principles of the Apache Hadoop ecosystem including Hadoop Distributed File System, MapReduce, and Apache YARN. **K2**
- CO3** Demonstrate the use of **NoSQL databases** such as **MongoDB** and **Apache Cassandra** for managing and storing large-scale distributed data. **K3**
- CO4** Apply the **MapReduce** programming model and query big data using tools like **Apache Hive** and **Apache Pig**. **K3**
- CO5** Analyze large datasets using **Apache Spark**, including **Spark SQL**, **MLlib**, and **Spark Streaming** for data analytics and machine learning tasks. **K4**
- CO6** Evaluate big data processing techniques and design data analytics workflows for real-time and batch data processing using modern big data platforms. **K5**

Unit I

(18 Hours)

Introduction - Need of Big Data - Big Data - Classification of Data-Structured, Semi-structured and Unstructured - Big Data Definitions - Big Data Characteristics - Big Data Types - Big Data Classification - Big Data Handling Techniques - Scalability and Parallel Processing - Analytics Scalability to Big Data - Massively Parallel Processing Platforms - Cloud Computing - Grid and Cluster Computing - Volunteer Computing - Designing Data Architecture - Data Architecture Design - Managing Data for Analysis - Data Sources, Quality, Pre-Processing and Storing - Data Sources - Data Quality - Data Pre-processing - Data Store Export to Cloud - Data Storage and Analysis - Data Storage and Management: Traditional Systems - Big Data Storage - Big Data Platform - Big Data Analytics - Big Data Analytics Applications and Case Studies - Big Data in Marketing and Sales - Big Data and Healthcare - Big Data in Medicine - Big Data in Advertising.

Unit II

(18 Hours)

Introduction to Hadoop – Introduction - Hadoop and its Ecosystem - Hadoop Core Components - Features of Hadoop - Hadoop Ecosystem Components - Hadoop Streaming - Hadoop Pipes - Hadoop Distributed File System - HDFS Data Storage - HDFS Commands - MapReduce Framework and Programming Model - Hadoop MapReduce Framework - MapReduce

Programming Model - Hadoop Yarn - Hadoop 2 Execution Model - Hadoop Ecosystem Tools - Hadoop Ecosystem – Ambari – Hbase – Hive – Pig – Mahout.

Unit III

(18 Hours)

NoSQL Big Data Management, MongoDB and Cassandra – Introduction - NoSQL Data Store – NOSQL - Schema-less Models - Increasing Flexibility for Data Manipulation - NoSQL Data Architecture Patterns - Key-Value Store - Document Store - Tabular Data - Object Data Store - Graph Database - Variations of NoSQL Architectural Patterns - NoSQL to Manage Big Data - Using NoSQL to Manage Big Data - Shared-Nothing Architecture for Big Data Tasks - Choosing the Distribution Models - Ways of Handling Big Data Problems - MongoDB Database - Cassandra Databases.

Unit IV

(18 Hours)

MapReduce, Hive and Pig – Introduction - MapReduce Map Tasks, Reduce Tasks and MapReduce Execution - Map-Tasks - Key-Value Pair - Grouping by Key – Partitioning – Combiners - Reduce Tasks - Details of MapReduce Processing Steps - Coping with Node Failures - Composing MapReduce for Calculations and Algorithms - Composing Map-Reduce for Calculations - Matrix-Vector Multiplication by MapReduce - Relational-Algebra Operations - Matrix Multiplication – Hive - Hive Architecture - Hive Installation - Comparison with RDBMS (Traditional Database) - Hive Data Types and File Formats - Hive Data Model - Hive Integration and Workflow Steps - Hive Built-in Functions – HiveQL - HiveQL Data Definition Language (DDL) - HiveQL Data Manipulation Language (DML) - HiveQL For Querying the Data – Aggregation – Join - Group by Clause – Pig - Apache Pig - Grunt Shell - Installing Pig - Pig Latin Data Model - Pig Latin and Developing Pig Latin Scripts.

Unit V

(18 Hours)

Spark and Big Data Analytics – Introduction – Spark - Introduction to Big Data Tool-Spark - Introduction to Data Analysis with Spark - Spark SQL - Using Python Advanced Features with Spark SQL - Data Analysis Operations - Downloading Spark, and Programming using RDDs and MLIB - Downloading, Installing Spark and Getting Started - Programming with RDD - Machine Learning with MLlib - Data ETL (Extract, Transform and Load) Process - Composing Spark Program Steps for ETL - Introduction to Analytics, Reporting and Visualizing - Introduction to Analytics - Data/Information Reporting - Data Visualization. Data Stream Mining and Real-Time Analytics Platform Spark Streaming – Introduction - Data Stream Concepts and Data Stream Management - Stream Computing Aspects - Frequent Itemsets - Real-time Analytics Platform (RTAP)- Spark Streaming.

Text Book:

1. Raj Kamal, Preeti Saxena, “Big Data Analytics – Introduction to Hadoop, Spark and Machine Learning”, Tata McGraw Hill Ltd., 2019.

Reference Books:

1. Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, “Big data for dummies”, John Wiley & Sons, Inc. (2013).

2. Tom White, “Hadoop The Definitive Guide”, O’Reilly Publications, Fourth Edition, 2015.
3. Dirk Deroos, Paul C.Zikopoulos, Roman B.Melnky, Bruce Brown, Rafael Coss, “Hadoop For Dummies”, Wiley Publications, 2014

Web References:

1. <https://www.databricks.com/glossary/mapreduce>
2. <https://www.geeksforgeeks.org/blogs/data-stream-in-data-analytics/>
3. https://piazza.com/class_profile/get_resource/hbkyg1fhwza2k1/hetzygtx1tj5gd

DEEP LEARNING

(26PCSE31)

SEMESTER-III ELECTIVE- 5 HOURS-3 CREDITS-3 TOTAL HOURS: 45

Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Remember concepts of machine learning, linear algebra, and deep neural networks.	K1
CO2	Explain principles of CNNs and RNNs.	K2
CO3	Apply CNNs and RNNs to classification and sequence problems.	K3
CO4	Analyze performance of deep learning models using metrics.	K4
CO5	Evaluate autoencoders and generative models for applications.	K5
CO6	Design and develop deep learning solutions with training and validation	K6

UNIT I

(9 Hours)

Linear Algebra: Scalars-Vectors-Matrices and tensors-Probability Distributions - Machine Learning Basics: Capacity-Overfitting and underfitting- Hyperparameters and validation sets- Estimators, Bias and variance-Stochastic gradient descent-Deep Networks: Deep feedforward networks- Regularization - Optimization.

UNIT II

(9 Hours)

Convolution Operation-Sparse Interaction-Parameter Sharing-Equivaria-Pooling-Convolution Variants: Strided-Tiled-Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions-Loss Functions-Regularization-Optimizers-Gradient Computation.

UNIT III

(9 Hours)

Unfolding Graphs-RNN Design Patterns : Acceptor-Encoder-Transducer; Gradient Computation-Sequence Modeling Conditioned on Contexts-Bidirectional RNN-Sequence to Sequence RNN-Deep Recurrent Networks-Recursive Networks- Recursive Neural Networks--Long Term Dependencies ; Leaky Units : Skip connections and dropouts ; Gated Architecture : LSTM.

UNIT IV

(9 Hours)

Performance metrics-Baseline Models-Hyperparameters : Manual Hyperparameter-Automatic Hyperparameter-Grid search-Random search-Debugging strategies.

UNIT V

(9 Hours)

Autoencoders: Under complete autoencoders-Regularized autoencoders-Stochastic encoders and decoders-Learning with autoencoders ; Deep Generative Models : Variational autoencoders-Generative adversarial networks.

Text Book:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning, MIT Press, 2022

Reference Books:

1. Nikhil Buduma, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithm”, O’Reilly, 2017.
2. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.

Web Resources:

1. <https://nptel.ac.in/courses/106106184>
2. <https://www.geeksforgeeks.org/introduction-deep-learning/>
3. <https://www.geeksforgeeks.org/auto-encoders/>
4. <https://www.javatpoint.com/hyperparameters-in-machine-learning>

NETWORK SECURITY AND CRYPTOGRAPHY
(26PCSE31)

SEMESTER-III ELECTIVE-5 HOURS-3 CREDITS-3 TOTAL HOURS:45

Course Outcomes:

Upon completion of the course, the students will be able to

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|--|-----------|
| CO1: Recall fundamental concepts of network security and basic cryptographic principles. | K1 |
| CO2: Compare symmetric and asymmetric cryptographic techniques to solve problems related to confidentiality and authentication. | K2 |
| CO3: Apply number theory concepts, cryptographic hash functions and digital signature algorithms for secure data communication. | K3 |
| CO4: Analyze key management, authentication mechanisms, X.509 certificates for secure network operations. | K4 |
| CO5: Evaluate web security mechanisms using security policies. | K5 |
| CO6: Implement cryptographic algorithms (RSA, DSA, ECC) and assess real-world security scenarios. | K6 |

UNIT I **(9 Hours)**

Information and Network Security Concepts – Security Attacks – Security Services –Security Mechanisms – Cryptography – Network Security. Classical Encryption techniques: Symmetric Cipher Model – Substitution Techniques -Transposition Techniques. Block Ciphers and DES: Traditional Block Cipher Structure - The Data Encryption Standard - A DES Example - The Strength of DES – Block Cipher Design Principles.

UNIT II **(9 Hours)**

Introduction to Number Theory: The Euclidean Algorithm – Modular Arithmetic. Advanced Encryption Standard: Finite Field Arithmetic - AES Structure - AES Transformation Functions - AES Key Expansion - An AES Example. Public Key Cryptography and RSA: Principles of Public-Key Cryptosystems - The RSA Algorithm – Other Public-Key Cryptosystems: Diffie-Hellman Key Exchange.

UNIT III **(9 Hours)**

Cryptographic Hash functions: Two simple Hash Functions - SHA Algorithm. Cryptographic Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption - Symmetric Key Distribution Using Asymmetric Encryption - Distribution of Public Keys - X.509 Certificates - Public-Key Infrastructure.

UNIT IV **(9 Hours)**

Transport-Level Security: Web Security Considerations -Transport Layer Security – HTTPS - Secure Shell (SSH). Wireless Network Security: Wireless Security - IEEE 802.11 Wireless Lan Overview - IEEE 802.11i Wireless Lan Security. E-mail Security: Internet Mail Architecture - Email Formats - Email Threats and Comprehensive Email Security - S/MIME 609.

UNIT V

(9 Hours)

IP Security: Overview – IP Security Policy. Network End Point Security: Firewalls – Intrusion Detection Systems – Malicious Software- Distributed Denial of Service Attacks. Internet of Things (IoT) Security: The Internet of Things - IoT Security Concepts and Objectives - An Open-Source IoT Security Module.

Text Book:

William Stallings, “Cryptography and Network Security”, PHI/ Pearson Education Edition (Global Edition), Eighth Edition, 2023.

Reference Books:

1. Douglas Robert Stinson, Maura Paterson, “Cryptography: Theory and Practice”, CRC Press, Fourth Edition, 2023.
2. A.Menezes, P Van Oorschot and S.Vanstone, “Hand Book of Applied Cryptography”, CRC Press, 1997.
3. Ankit Fadia, “Network Security”, Premier Press, 2002, Second Edition.
4. Bruce Schneir, “Applied Cryptography”, Wiley Publications, Second Edition, 2017.

Web Resources:

1. <https://nptel.ac.in/courses/106/105/106105031>
2. <http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html>
3. <https://www.tutorialspoint.com/cryptography/index.htm>

**ROBOTICS PROCESS AUTOMATION - LAB
(26PCSS31)**

SEMESTER – III SEC - 2 HOURS – 3 CREDITS – 2 TOTAL HOURS – 45

Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Become adept in automating Windows, web, and Java-based applications	K2
CO2	Understand fundamental UI automation concepts	K2
CO3	Apply and Analyze the ability to create and debug workflows using UiPath	K4
CO4	Master installation of UiPath Studio on Windows	K5
CO5	Create and implement error exception handling in UiPath	K5
CO6	Create applications using RPA	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

List of Practical's:

1. Create a sequence that asks the user for his first and last name, and gives him choices to order from his favourite snacks, and shows the welcome message only if the user enters the correct password, then displays his answers.
2. Write a program to calculate the current age and design a workflow for an integer variable will increase from 5 to 50 in increments of 5.
3. Design a Process to perform a basic calculation using Arguments.
4. Build a Guessing game using a Flow Chart
5. Create an automation process that goes through each element of an array write the length of array and each element to output panel.
6. Design a workflow for transactional process using State Machine
7. Design a process to read all PDF files from a folder and then close them all.
8. Automate word file using basic recording and Automate Calculator Application using Desktop recoding.
9. Design a process to Extract Initial name from full name
10. Design a process to read text and Merge Multiple word files into one file.
11. Create an automation for PDF to Text Conversion
12. Create a workflow to perform OCR-based text extraction from scanned images and store the output in a text file.
13. Design a bot to classify documents (invoice, receipt, letter) using AI-based document understanding.
14. Create a workflow to integrate sentiment analysis on customer feedback using an AI service and store results in Excel.
15. Design an end-to-end hyper automation scenario combining RPA + OCR + NLP + Excel/Database integration.

DIGITAL IMAGE PROCESSING
26PCSC41

SEMESTER–IV CORE-12 HOURS–6 CREDITS–5 TOTAL HOURS: 90

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1	Define basic concepts of Digital Image Processing and image processing systems	K1
CO2	Explain image formation, sampling, quantization, and pixel operations	K2
CO3	Apply spatial image enhancement techniques and filtering methods	K3
CO4	Analyze image degradation models and restoration techniques	K4
CO5	Evaluate lossless and lossy image compression methods	K5
CO6	Design image segmentation techniques for object extraction	K6

UNIT I **(18 Hours)**

Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations.

UNIT II **(18 Hours)**

Image Enhancement in the spatial domain:- Background – some basic Gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods. Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and Frequency Domain- Smoothing Frequency- Domain Filters-Sharpening Frequency Domain Filter.

UNIT III **(18 Hours)**

Image Restoration: A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations. Color Image Processing: Color Fundamentals- Color Transformation-Color Segmentation.

UNIT IV **(18 Hours)**

Image Compression: Fundamentals–Image compression models–Elements of Information Theory – Error Free compression – Lossless compression: Variable length coding – LZW coding – Bit plane coding predictive coding-Lossy compression – Transform coding – Wavelet coding - Image compression standards.

UNIT V

(18 Hours)

Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Second Edition, PHI/Pearson Education. (Unit I,II,III,IV)
2. B. Chanda, D.Dutta Majumder, “Digital Image Processing and Analysis”, PHI, 2003.(Unit V)

REFERENCE BOOKS:

1. NickEfford,“Digital Image Processing a practical introducing using Java”, Pearson Education, 2004.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/117/105/117105135/>
2. <https://www.tutorialspoint.com/dip/index.html>
3. <https://www.javatpoint.com/digital-image-processing-tutorial>

DIGITAL IMAGE PROCESSING LAB USING PYTHON (26PCSC42)

SEMESTER-IV CORE-13 HOURS-6 CREDITS-5 TOTAL HOURS: 90

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1	Recall basic concepts of digital images and image processing operations using python.	K2
CO2	Explain image sampling, quantization, noise, and basic pixel operations using Python.	K3
CO3	Apply image enhancement, filtering, histogram processing, subtraction, and geometric transformations using Python.	K4
CO4	Analyze noise effects and image restoration techniques using Python.	K4
CO5	Evaluate image compression techniques and their performance using Python.	K5
CO6	Design and implement image segmentation, edge detection, and morphological operations using Python.	K6

List of Programs

1. Implement Image Enhancement Techniques
2. Perform Histogram Equalization
3. Implement Image Restoration
4. Implement Image Filtering
5. Perform Edge Detection using Roberts, Prewitt, and Sobel Operators
6. Implement Image Compression
7. Perform Image Subtraction
8. Extract Boundaries using Morphological Operations
9. Implement Image Segmentation
10. Implement Image Sampling and Quantization
11. Add Noise to an Image
12. Remove Noise using Filtering Techniques
13. Perform Threshold-Based Image Segmentation
14. Implement Geometric Transformations

INTERNET OF THINGS

(26PCSE41)

SEMESTER-IV ELECTIVE-6 HOURS-4 CREDITS-3 TOTAL
HOURS: 60

Course Outcomes:

Upon completion of the course, the students will be able to

- CO1** Explain the fundamental concepts, architecture, technologies, and design principles of IoT and M2M systems, including system layers, communication technologies, and gateway functions. **K2**
- CO2** Analyze and compare communication models and protocols for connected devices, including message protocols, web services, IP addressing, MAC, and application-layer protocols. **K4**
- CO3** Apply data acquisition, organization, storage, and cloud computing paradigms to manage IoT data using cloud service models and enterprise integration approaches. **K3**
- CO4** Evaluate sensor technologies, RFID, wireless sensor networks, and embedded platforms used for prototyping IoT and M2M devices. **K5**
- CO5** Develop and prototype embedded software and cloud-based services for IoT applications, including device, gateway, API, and web service integration. **K6**
- CO6** Assess security vulnerabilities, threat models, and security protocols in IoT systems, and design secure IoT solutions for real-world applications such as supply chain and connected vehicles. **K5**

UNIT I

(12 Hours)

Internet of Things: An Overview: IoT Conceptual Framework - IoT Architectural View - Technology Behind IoT - Sources of IoT - M2M Communication - Examples of IoT - Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization - Communication Technologies - Data Enrichment, Data Consolidation and Device Management at Gateway.

UNIT II

(12 Hours)

Communication Protocols for Connected Devices– Message Communication Protocols for Connected Devices – Web Connectivity for Connected Devices – Network using Gateway , SOAP, REST, HTTP, RESTful and Web Sockets -Internet Connectivity Principles Internet Connectivity - Internet Based Communication – IP Addressing in the IoT – Media Access Control – Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others

UNIT III

(12 Hours)

Data Acquiring and Storage – Organizing the Data – Transactions, Business Processes, Integration and Enterprise Systems – Analytics – Knowledge Acquiring, Managing and Storing Processes – Data Collection, Storage and Computing Using a Cloud Platform: Cloud Computing Paradigm for Data Collection, Storage and Computing – Everything as a Service and Cloud Service Models.

UNIT IV

(12 Hours)

Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks: Sensor Technology – Wireless Sensor Networks Technology - Prototyping the Embedded Devices for IoT and M2M: Embedded Computing Basics – Embedded Platforms for Prototyping.

UNIT V

(12 Hours)

Prototyping Embedded Device Software - Devices, Gateways, Internet and Web/ Cloud Services Software Development – Prototyping online Component APIs and Web APIs – Security for IoT: Vulnerabilities, Security Requirements and Threat Analysis – IoT Security Tomography and Layered Attacker Model – Security Models, Profiles and Protocols for IoT – IoT Application Case Study: Design Layers, Design Complexity and Designing using Cloud PaaS – IoT / IoT Applications in the premises, Supply – Chain and Customer Monitoring – Connected Car and its Applications and Services.

Text Book:

1. Raj Kamal, “Internet of Things Architecture and Design Principles”, McGraw Hill, 2017

Reference Books:

1. Ovidiu Vermesan and Peter Friess, “Internet of Things – From Research and Innovation to Mark Deployment”, River Publishers, 2014.
2. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015.
3. Donald Norris, “The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black”, Mc Graw Hill, 2015

Web References:

- 1 https://onlinecourses.nptel.ac.in/noc20_cs66/preview
- 2 <https://www.javatpoint.com/iot-internet-of-things>
- 3 https://www.tutorialspoint.com/internet_of_things/index.htm

**EMBEDDED SYSTEMS
(26PCSE41)**

SEMESTER IV	HOURS-4	CREDITS-3	TOTAL HOURS-60
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COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

- | | | |
|-------------|---|-----------|
| CO 1 | Explain the fundamental concepts, characteristics, components, and architecture of embedded systems | K2 |
| CO 2 | Interpret the role of embedded processors, memory organization, interrupts, timers, and interfacing mechanisms in embedded systems. | K2 |
| CO 3 | Apply embedded programming concepts and development tools for designing and debugging embedded software. | K3 |
| CO 4 | Analyse real-time system requirements, scheduling algorithms, and synchronization techniques used in RTOS. | K4 |
| CO 5 | Evaluate embedded system design methodologies and applications across domains such as IoT, automation, and consumer electronics. | K5 |
| CO 6 | Design embedded solutions by integrating hardware, software, and real-time concepts for practical applications. | K6 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Unit I:

12 Hours

Embedded systems: definition, characteristics and applications – embedded systems vs general purpose computing systems – history and evolution of embedded systems – components of embedded systems – hardware and software components – sensors and actuators – memory and input/output devices – embedded system architecture – microprocessors vs microcontrollers – system-on-chip (SoC) – design constraints and performance requirements.

Unit II:

12 Hours

Embedded processors – types of processors used in embedded systems – microcontrollers and digital signal processors – memory organization – RAM, ROM, flash memory – buses and communication interfaces – interrupts and interrupt handling – timers and counters – watchdog timer – power management in embedded systems – interfacing with sensors and actuators.

Unit III:

12 Hours

Embedded software development – embedded programming concepts – embedded C programming basics – device drivers – firmware development – cross compilers and assemblers – debugging tools – simulators and emulators – integrated development environment (IDE) – embedded system design flow – hardware–software co-design – testing and debugging techniques.

Unit IV:**12 Hours**

Introduction to real-time systems – characteristics of real-time systems – tasks, processes and threads – scheduling algorithms – preemptive and non-preemptive scheduling – inter-process communication – synchronization mechanisms – semaphores and message queues – memory management – RTOS examples and applications.

Unit V:**12 Hours**

Embedded system design methodology – embedded product development life cycle – case studies of embedded systems – automotive systems – consumer electronics – medical devices – industrial automation – Internet of Things (IoT) and embedded systems – security issues in embedded systems – future trends in embedded computing.

Text Books

1. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, 2nd ed. Cambridge, MA, USA: MIT Press, 2023. **(Chapters 1, 2, 6).**
2. R. Kamal, Embedded Systems: Architecture, Programming and Design, 3rd ed. New Delhi, India: McGraw Hill Education, 2019. **(Chapters 2, 3, 4, 5, 12, 13).**

Reference Book:

1. P. Marwedel, Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems and the Internet of Things, Cham, Switzerland: Springer, 2021.

Web References

1. <https://www.geeksforgeeks.org/introduction-of-embedded-systems-set-1/>
2. <https://nptel.ac.in/courses/108/102/108102045>
3. https://www.tutorialspoint.com/embedded_systems/index.htm
4. <https://ocw.mit.edu/courses/6-08-introduction-to-embedded-systems-spring-2011/>

**ADVANCED DATABASE MANAGEMENT SYSTEMS
(26PCSS41)**

SEMESTER IV	SEC3	HOURS-4	CREDITS-2	TOTAL HOURS-60
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COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

- | | | |
|-------------|--|-----------|
| CO 1 | Explain relational data model concepts, constraints, anomalies, and OOP principles. | K2 |
| CO 2 | Apply object-oriented and object-relational database concepts using ODL, OQL, and SQL features | K3 |
| CO 3 | Analyze parallel and distributed database architectures and query processing techniques | K4 |
| CO 4 | Evaluate data warehousing, OLAP, and decision support techniques. | K5 |
| CO 5 | Analyze data mining techniques for knowledge discovery | K4 |
| CO 6 | Design database solutions using advanced data models for modern applications | K6 |
- K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create**

UNIT I	(12 Hours)
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Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations. Overview of Object-Oriented Concepts – Objects, Basic properties. Advantages, examples, Abstract data types, Encapsulation, class hierarchies, polymorphism, examples..

UNIT II	(12 Hours)
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Object and Object-Relational Databases: Overview of OOP; Complex objects; Identity, structure etc. Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Conceptual design of Object database. Overview of object relational features of SQL; Object-relational features of Oracle; Implementation and related issues for extended type systems; syntax and demo examples, The nested relational model. Overview of C++ language binding;

UNIT III	(12 Hours)
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Parallel and Distributed Databases: Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.

UNIT IV	(12 Hours)
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Data Warehousing, Business Intelligence, and Dimensional Modeling Primer - Different Worlds of Data Capture and Data Analysis - Goals of Data Warehousing and Business Intelligence - Publishing Metaphor for DW/BI Managers - Dimensional Modeling Introduction - Star Schemas Versus OLAP Cubes - Fact Tables for Measurements - Dimension Tables for Descriptive

Context - Facts and Dimensions Joined in a Star Schema - Kimball's DW/BI Architecture - Operational Source Systems - Extract, Transformation, and Load System - Presentation Area to Support Business Intelligence- Business Intelligence Applications - Restaurant Metaphor for the Kimball Architecture .

UNIT V

(12 Hours)

Building the Data Warehouse: Business Dimensional Lifecycle Road Map - Road Map Major Points of Interest - Project Planning and Management- Assessing Readiness - Scoping - Justification - Staffing - Developing and Maintaining the Project Plan - Business Requirements Definition - Requirements Preplanning - Collecting the Business Requirements -Postcollection Documentation and Follow-up - Lifecycle Technology Track -Technical Architecture Design - Eight-Step Process for Creating the Technical Architecture

Text Books:

1. Elmasri and Navathe: Fundamentals of Database Systems, Pearson Education, 2013. (Unit I & II)
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2013. (Unit III)
3. Ralph Kimball Margy Ross. The data warehouse toolkit : the complete guide to dimensional modeling.- Third Edition ,Wiley Computer Publishing (Unit IV & V)

References Books:

1. Korth, Silberschatz, Sudarshan, Database System Concepts,
2. Rob and Coronel, Database Systems: Design, Implementation and Management,
3. Date and Longman, Introduction to Database Systems.

Web References:

1. <https://www.geeksforgeeks.org/dbms/introduction-of-dbms-database-management-system-set-1/>
2. <https://www.w3schools.in/dbms>

**PROFESSIONAL COMPETENCY SKILL
(26PCSS41)**

SEMESTER IV SEC3 HOURS-4 CREDITS-2 TOTAL HOURS-60

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

- | | | |
|-------------|--|-----------|
| CO 1 | Demonstrate effective verbal, non-verbal, written, and presentation skills for professional communication | K3 |
| CO 2 | Apply verbal ability techniques to improve English language proficiency | K3 |
| CO 3 | Solve quantitative aptitude, logical reasoning, and data interpretation problems using suitable strategies | K3 |
| CO 4 | Develop programs using fundamental programming concepts with proper debugging and exception handling | K3 |
| CO 5 | Analyze and implement data structures, OOPS, databases, and version control to solve technical problems. | K4 |
| CO 6 | Design and conduct research studies using appropriate methods, ethics, and academic writing standards. | K4 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

UNIT I: Communication Skills (12 Hours)

Verbal Communication: Public speaking, Group discussions, and Interview handling. Non-verbal Communication: Body language, Gestures, Listening skills. Written Communication: Résumé writing, Email etiquette, Cover letters, Report Writing. Presentation Skills: Visual aids, Audience engagement, Delivery techniques.

English (Verbal Ability): Passage/Sentence Rearrangement, Error Detection and Correction, fill in the Blanks, Reading Comprehension Passages, Sentence Completion, Synonyms and Antonyms, Words Completion, Para jumbles etc.

UNIT II: General Aptitude (12 Hours)

Quantitative Aptitude: Number systems, Ratios, Percentages, Averages, Time & Work, Probability. Logical Reasoning: Series, Puzzles, Syllogisms, Direction sense, Blood relations. Data Interpretation: Tables, Pie charts, Graphs.

UNIT III: Basic Coding Skills (12 Hours)

Basic Programming Concepts, Syntax and semantics, Input/output handling, Variables, data types, Loops. Functions and recursion. Arrays, strings. Sorting and searching, Pointers (C/C++) / References (Java/Python). Exception handling (Java, Python).

UNIT IV: Competitive Coding Skills (12 Hours)

)Introduction to Data Structures: Linked Lists (Singly, Doubly), Problem solving using linked lists. Stacks, Queues, Trees (Binary, BST, basic traversals), Heaps (Min/Max heap concepts), Graphs (Adjacency list/matrix, BFS, DFS), Sets (HashSet, TreeSet). OOPS concepts:

Encapsulation, Abstraction, Inheritance and Polymorphism. Introduction to Databases, ER-model, basics of SQL. Version Control: Git, GitHub.

UNIT V Research Methodology:

(12 Hours)

Introduction to Research: Meaning, Types (Basic, Applied, Experimental) -Research Process: Problem identification, literature survey, hypothesis formulation -Research design and methodology - Quantitative and qualitative research methods - Data collection techniques (surveys, experiments, simulations) - Data analysis tools and interpretation - Writing research papers (structure of IEEE format) - Plagiarism and citation styles (APA/IEEE) - Intellectual Property Rights (IPR) and patents - Research ethics and academic integrity

Text Books

1. Bovee, C. L., & Thill, J. V., *Business Communication Today*, 14th Edition, Pearson Education, 2020. (Unit I)
2. Kumar, S., & Lata, P., *Communication Skills*, 2nd Edition, Oxford University Press, 2018. (Unit I)
3. Aggarwal, R. S., *Quantitative Aptitude for Competitive Examinations*, Revised Edition, S. Chand & Company Ltd., New Delhi, 2022. (Unit II)
4. Aggarwal, R. S., *A Modern Approach to Logical Reasoning*, Revised Edition, S. Chand & Company Ltd., New Delhi, 2021. (Unit II)
5. Balagurusamy, E., *Programming in ANSI C*, 8th Edition, McGraw Hill Education, 2019. (Unit III)
6. Kanetkar, Y., *Let Us C*, 17th Edition, BPB Publications, New Delhi, 2020. (Unit III)
7. Thareja, R., *Python Programming using Problem Solving Approach*, Oxford University Press, New Delhi, 2017. (Unit III)
8. Thareja, R., *Data Structures Using C*, 2nd Edition, Oxford University Press, New Delhi, 2014. (Unit IV)
9. Karumanchi, N., *Data Structures and Algorithms Made Easy*, 5th Edition, CareerMonk Publications, Hyderabad, 2020. (Unit IV)
10. Bayross, I., *SQL, PL/SQL: The Programming Language of Oracle*, 6th Edition, BPB Publications, New Delhi, 2018. (Unit IV)
11. Chacon, S., & Straub, B., *Pro Git*, 2nd Edition, Apress Media LLC, 2014.
12. Kothari, C. R., *Research Methodology: Methods and Techniques*, 3rd Edition, New Age International Publishers, New Delhi, 2019. (Unit V)
13. Panneerselvam, R., *Research Methodology*, 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2021. (Unit V)

Web references:

1. <https://in.indeed.com/career-advice>
2. <https://www.indiabix.com/>
3. <https://docs.python.org/>
4. <https://docs.oracle.com/en/java>
5. <https://www.hackerrank.com/>
6. <https://docs.github.com/>
7. <https://dev.mysql.com/doc>
8. <https://apastyle.apa.org/>
9. <https://www.wipo.int/portal/en>
10. <https://www.turnitin.com/>

**MOBILE APPLICATION DEVELOPMENT
(26PCSEC1)**

SEMESTER-I ECC-1 CREDITS-3

Course Outcomes:

Upon completion of the course, the students will be able to

- | | | |
|------------|--|-----------|
| CO1 | Explain the fundamentals of Flutter and Dart, including variables, data types, control structures, functions, and the Flutter development environment. | K2 |
| CO2 | Compare Flutter with native and other cross-platform frameworks, and demonstrate object-oriented programming concepts, generics, enums, and asynchronous programming in Dart. | K3 |
| CO3 | Develop responsive user interfaces using various Flutter widgets, manage state using stateful/stateless widgets, streams, and implement form handling with custom input widgets. | K3 |
| CO4 | Implement navigation between screens using routing techniques, pass data across screens, and integrate plugins including Firebase in Flutter applications. | K3 |
| CO5 | Design and implement animations and widget transformations using Flutter animation classes and animated widgets. | K4 |
| CO6 | Test, debug, and deploy Flutter applications on Android, iOS, and web platforms, including performance monitoring and crash tracking. | K5 |

UNIT I **(6 Hours)**

An Introduction to Flutter: Technical requirements – Introduction - Hello Flutter – a first glimpse of Flutter - Widgets, widgets, everywhere - Building and running Flutter - An Introduction to Dart: Technical requirements - Getting started with Dart - Variables and data types - Control flows and looping - Functions and methods.

UNIT II **(6 Hours)**

Flutter versus Other Frameworks: Native development - Cross-platform frameworks – Flutter community - Flutter strengths and weaknesses - Dart Classes and Constructs - Technical requirements - Object orientation in Dart - Understanding classes in Dart -The enum type - Using generics - Asynchronous programming.

UNIT III **(6 Hours)**

Widgets – Building Layouts in Flutter: Technical requirements - Stateful/stateless widgets - Streams - Handling User Input and Gestures: Technical requirements - Handling user gestures - A deeper look at the stateful widget life cycle - Input widgets and forms - Custom input and FormField widgets.

UNIT IV **(6 Hours)**

Routing – Navigating between Screens: Technical requirements - Understanding the Navigator widget - Screen transitions - Passing data between screens – Plugins: Technical requirements – Introduction – Working of Plugins on iOS and Android - Popular Third-Party Plugins: Technical requirements - Exploring Firebase plugins.

UNIT V

(6 Hours)

Using Widget Manipulations and Animations: Technical requirements - Transforming widgets with the Transform class - Introducing animations - Using animations - Using AnimatedBuilder - Implicitly animated widgets - Testing and Debugging: Technical requirements - Unit testing - Widget testing - Debugging your app - DevTools - Releasing Your App to the World: Technical requirements - Releasing your app on Android - Releasing your app on iOS - Releasing your app on the web - Tracking app usage and crashes.

Text Book:

1. Thomas Bailey, Alessandro Biessek, “Flutter for Beginners”, Packt Publishing, 2021

Reference Books:

1. Marco L. Napoli , “BEGINNING FLUTTER”, John Wiley & Sons, Inc., 2020.
2. Rap Payne , “Beginning App Development with Flutter”, APRESS, 2019.
3. Frank Zammetti , “Practical Flutter”, APRESS, 2019

Web References:

1. <https://codesignal.com/learn/courses/object-oriented-programming-in-dart/lessons/constructors-in-dart-building-and-initializing-objects>
2. <https://docs.flutterflow.io/concepts/layouts/>
3. <https://docs.flutter.dev/ui/widgets/animation>

COMPUTER VISION

(26PCSEC2)

SEMESTER-II

ECC-2

CREDITS-3

Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Remember the basic concepts and applications of computer vision	K1
CO2	Understand image formation, representation and processing techniques	K2
CO3	Apply image processing algorithms for feature extraction and segmentation	K3
CO4	Analyze and interpret visual data using computer vision techniques	K4
CO5	Evaluate the performance of computer vision models and methods	K3
CO6	Designs impel computer vision applications using modern tools and frameworks	K2

UNIT I

Introduction to Computer Vision: Definition, scope and applications–Human vision vs computer vision–Image formation and camera models–Digital image fundamentals–Image acquisition and representation–Colormodels(RGB,HSV,YCbCr)–Image sampling and quantization–Image noise and filtering basics.

UNIT II

Image Processing Techniques: Image enhancement(contrast stretching, histogram equalization)–Spatial domain filtering (smoothing and sharpening)–Frequency domain filtering (Fouriertransform basics)–Edge detection(Sobel, Prewitt, Canny)–Image segmentation (thresholding,regiongrowing,watershed)–Morphological operations (dilation, erosion, opening, closing).

UNIT III

Feature Detection and Matching: Feature types (corners, blobs, edges)–Corner detection (Harris)–Blobdetection(LoG,DoG)–Featuredescriptors(SIFT,SURF,ORB)–Feature matching–RANSAC for robust matching– Homography and image alignment– Template matching.

UNIT IV

Object Detection and Recognition: Pattern recognition basics–Template matching– HOG featureandSVMclassifier–Facedetection(Viola–Jones)–Facerecognition overview–Object detection(YOLO/SSD–concept)–Introductiontodeeplearninginvision–CNN basics.

UNIT V

AdvancedTopicsandApplications:3Dvision and stereovision–Optical flow and motion tracking–Video analysis and background subtraction–Augmentedreality basics–Vision applications in healthcare, surveillance, autonomous vehicles–Ethical issues and challenges

in computer vision.

TextBook:

1. RichardSzeliski,ComputerVision:AlgorithmsandApplications,Springer.

ReferenceBooks:

1. RafaelC.Gonzalez&RichardE.Woods,Digital ImageProcessing,Pearson
2. E.R.Davies, Computer Vision:Principles, Algorithms, Applications, Academic Press
3. MilanSonkaetal.,ImageProcessing,AnalysisandMachineVision,Cengage

Web Resources:

- 1 <https://www.simplilearn.com/computer-vision-article>
- 2 <https://www.javatpoint.com/computer-vision>
- 3 https://www.sas.com/en_in/insights/analytics/computer-vision.html

GREEN COMPUTING

(26PCSEC3)

SEMESTER-III

ECC-3

CREDITS-3

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

- | | |
|---|-----------|
| CO 1 List the concepts, objectives, importance, and benefits of green computing. | K1 |
| CO 2 Explain energy-efficient techniques, virtualization, cloud computing, and resource optimization. | K2 |
| CO 3 Apply green computing practices in smart cities, IoT, AI, and renewable energy integration. | K3 |
| CO 4 Identify techniques for finding green devices, managing servers, and saving energy. | K4 |
| CO 5 Assess strategies to reduce emissions, resource use, and implement green practices in industries. | K5 |
| CO 6 Design innovative solutions for sustainable ICT systems and applications. | K6 |
- K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create**

Unit I:

Concept of green computing - importance of green computing - objectives and benefits - environmental impact of ICT - role of ICT in sustainable development - policies and standards - societal benefits of sustainable ICT practices. Students learn the basics and understand why sustainable computing is essential.

Unit II:

Focuses on energy-efficient hardware and software - virtualization - cloud computing - algorithmic efficiency - resource optimization - lifecycle analysis - ecological impact reduction. Students explore practical methods to reduce energy use and environmental impact in IT operations.

Unit III:

Green computing in smart cities, IoT, and AI - renewable energy integration - metrics for evaluating green ICT initiatives - case studies of sustainable projects - emerging trends and innovations in green computing.

Unit IV:

Covers - finding green devices - selecting energy-efficient desktops, laptops, tablets, and suppliers - green servers and data centers - best practices to reduce energy consumption in IT

infrastructure - saving energy - techniques to monitor and cut energy use and implement energy-saving projects.

Unit V:

Covers - reducing greenhouse gas emissions - approaches to lower carbon footprint from IT operations and supply chains - reducing resource use - recycling, smarter procurement, and sustainable practices - green computing by industry segment - applications across business sectors, evaluation of greenness measures, and real-world case studies.

Text Books:

1. M. A. Alam, S. Jain, and H. Parveen, Green Computing Approach Towards Sustainable Development, I K International Publishing House, 2019. **(Units 1, 2 & 3: Chapters 1, 3 & 4)**
2. Bud E. Smith, Green Computing Tools and Techniques for Saving Energy, Money and Resources, CRC Press, 2019. **(Units 4 & 5: Chapters 5, 6, 7, 8, 9, 10 & 11).**

Reference Books:

1. I. Ahmad and S. Ranka, Eds., Handbook of Energy-Aware and Green Computing. Chapman & Hall/Taylor & Francis, 2012.
2. R. Srivastava, S. Kautish, and R. Tiwari, Eds., Green Information and Communication Systems for a Sustainable Future. CRC Press, 2021.

Web References:

1. <https://www.ibm.com/think/topics/green-computing>
2. <https://www.hpe.com/us/en/what-is/green-computing.html>
3. <https://greenenotes.com/green-computing-sustainable-technology-for-future/>

BUSINESS INTELLIGENCE
(26PCSEC4)
SEMESTER-IV ECC-4 CREDITS-3

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

- | | | |
|-------------|---|-----------|
| CO 1 | Explain the basics of Business Intelligence, BI challenges, user models, and reporting. | K2 |
| CO 2 | Illustrate OLAP, dashboards, and emerging BI technologies. | K2 |
| CO 3 | Analyze the BI lifecycle and overall BI system. | K4 |
| CO 4 | Examine BI strategy, human factors, and architecture. | K4 |
| CO 5 | Apply BI project planning, requirement gathering, and development processes. | K3 |
| CO 6 | Evaluate BI databases, tools, and vendors. | K5 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

UNIT I

Introduction and Basics - Understanding Business Intelligence - Fitting BI with Other Technology Disciplines - Meeting the BI Challenge - Business Intelligence User Models - Basic Reporting and Querying.

UNIT II

OLAP: Online Analytical Processing - Dashboards and Briefing Books - Advanced / Emerging BI Technologies - The BI Lifecycle - The BI Big Picture

UNIT III

Human Factors in BI Implementations - Taking a Closer Look at BI Strategy - Building a Solid BI Architecture and Roadmap.

UNIT IV

Implementing BI - Building the BI Project Plan- Collecting User Requirements - BI Design and Development- The Day After: Maintenance and Enhancement.

UNIT V

BI and Technology - BI Target Databases: Data Warehouses, Marts, and Stores - BI Products and Vendors.

Text Book:

1. Business Intelligence for Dummies by Swain Scheps, Published by Wiley Publishing, Inc., Indianapolis, Indiana.

Reference Book:

1. Business Intelligence – The Umbrella Term, Deborah Quarles van Ufford November 2002

Web Reference:

1. <https://www.ibm.com/think/topics/business-intelligence>

VALUE ADDED COURSES
DATA VISUALISATION TOOLS
(26PCSV C1)

SEMESTER-1 CORE-VAC HOURS-3 CREDITS-2 TOTAL HOURS: 30

Course Outcomes:

Upon completion of the course, the students will be able to

CO1	Recall the principles, techniques, and design rules of data visualization	K1
CO2	Explain static and interactive visualizations using Python libraries	K2
CO3	Apply analytical visualizations using R and ggplot2	K3
CO4	Analyze interactive dashboards using Apache Superset	K4
CO5	Evaluate advanced visual layouts using RAWGraphs	K5
CO6	Develop web-based visualizations using Chart.js	K6

UNIT I (6 Hours)

FUNDAMENTALS OF DATA VISUALIZATION Introduction to Data Visualization- Importance of Visualization in Data Science- Types of Data: Structured, Semi-structured, Unstructured- Visualization Pipeline- Visual Perception & Cognition- Color Theory, Typography, and Layout- Visualization Ethics & Misleading Graphs- Overview of Visualization Tools Ecosystem

UNIT II (6 Hours)

DATA VISUALIZATION USING PYTHON-Python Visualization Ecosystem- Matplotlib Basics- Seaborn Statistical Visualizations- Plotly for Interactive Charts- Pandas Visualization- Customizing Plots- Exporting and Sharing Visuals

UNIT III (6 Hours)

DATA VISUALIZATION USING R- Introduction to R and RStudio- Grammar of Graphics- ggplot2 Structure- Geometric Objects and Aesthetics- Faceting and Themes- Interactive Visuals with Plotly in R- Visualization for Statistical Analysis

UNIT IV (6 Hours)

DASHBOARDING WITH APACHE SUPERSET & RAWGRAPHS- Installation Apache Superset- Connecting Data Sources- Creating Charts- Building Dashboards- Filters and Interactivity-

Role-based Access Control- **RAWGRAPHS**- Importing Data- Mapping Dimensions & Measures- Visual Models- Exporting SVG/PNG

UNIT V

(6 Hours)

WEB-BASED VISUALIZATION WITH CHART.JS- JavaScript Visualization Fundamentals- Chart.js Architecture- Bar, Line, Pie, Radar, Doughnut Charts- Dataset Handling- Custom Styling and Animations- Responsive Charts- Integration with HTML/CSS

Text Books:

1. Claus O. Wilke, “Fundamentals of Data Visualization”, O’Reilly Media, 2019. (Unit I)
2. Igor Milovanović, “Python Data Visualization Cookbook”, Packt publishing, 2nd Edition, 2020 (Unit II)
3. Hadley Wickham, “ggplot2: Elegant Graphics for Data Analysis”, 3rd Edition, Springer, 2023.(Unit III)
4. Kyran Dale, “Data visualization with Python and Javascript”, O’Reilly Media, 2nd edition, 2023 (Unit V)

Reference Books:

1. Cole Nussbaumer Knaflitz, “Storytelling with Data: A Data Visualization Guide for Business Professionals”, Wiley, 2015.
2. Andy Kirk, “Data Visualization: A Handbook for Data Driven Design”, Sage Publications, 2016.

Web Resources:

1. www.swayam-plus.swayam2.ac.in in Bing
2. onlinecourses.nptel.ac.in in Bing
3. swayam.gov.in in Bing

MERN STACK DEVELOPMENT

(26PCSV2)

SEMESTER-2 VAC – 2 HOURS – 3 CREDITS – 2 TOTAL HOURS: 30

Course Outcomes:

Upon completion of the course, the students will be able to

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

- | | | |
|-------------|---|-----------|
| CO 1 | Explain the architecture and components of MERN stack. | K2 |
| CO 2 | Develop responsive user interfaces using React. | K3 |
| CO 3 | Implement server-side logic using Node.js and Express.js. | K3 |
| CO 4 | Design and manage NoSQL databases using MongoDB. | K4 |
| CO 5 | Integrate frontend and backend using RESTful APIs. | K5 |
| CO 6 | Build, test, and deploy complete MERN stack applications. | K6 |

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

UNIT I (6 Hours)

Evolution of Web Technologies - Client-Server Architecture - Overview of MERN Stack - HTML5 & CSS3 Basics - JavaScript Fundamentals - Git & GitHub Basics - Development Environment Setup.

UNIT II (6 Hours)

React Architecture - JSX and Components - Props and State - Functional Components & Hooks - Event Handling - Forms and Validation - Routing using React Router - Styling in React

UNIT III (6 Hours)

Node.js Runtime & Modules - Express.js Framework – Middleware – Routing - REST API Development - Request & Response Handling - Error Handling.

UNIT IV (6 Hours)

NoSQL Concepts - MongoDB Architecture - CRUD Operations - Schema Design - Mongoose ODM - Indexing and Aggregation - Data Validation.

UNIT V (6 Hours)

Connecting React with Express - JWT Authentication & Authorization - Role-based Access – Control - Password Hashing - File Uploads - Testing with Postman - Deployment using Render/Heroku/Vercel - Introduction to Docker.

Text Books:

1. Ethan Brown, “Web Development with Node & Express”, Oreilly Publications, 2014. **(Unit – 2, 3)**
2. Alex Banks & Eve Porcello, “Learning React Modern Patterns for Developing React Apps”, Oreilly Publications, Second Edition, 2020. **(Unit - 5)**
3. Thompson carter, “FULL-STACK DEVELOPMENT WITH MERN: Building Scalable Applications with MongoDB, Express, React, and Node”. **(Unit – 1,4)**

Reference Books:

1. David Flanagan, “JavaScript The Definitive Guide Master the Worlds Most-Used Programming Language”, Oreilly Publications, Seventh Edition, 2020.
2. Kirupa Chinnathambi, “Learning React”, Addition Welsey Publication, 2017.

Web Resources:

1. <https://www.geeksforgeeks.org/courses/full-stack-node>.
2. <https://www.mygreatlearning.com/academy/learn-for-free/courses/mern-stack-fundamentals>
3. <https://www.geeksforgeeks.org/courses/full-stack-node>

QUANTUM COMPUTING

(26PCSV3)

SEMESTER – 1 VAC – 3 HOURS – 3 CREDITS – 2 TOTAL HOURS- 30

Course Outcomes:

Upon completion of the course, the students will be able to

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

- | | | |
|-------------|---|-----------|
| CO 1 | Explain fundamentals of quantum mechanics and linear algebra for quantum systems. | K2 |
| CO 2 | Apply Dirac notation to represent and manipulate quantum states. | K3 |
| CO 3 | Analyze quantum phenomena such as superposition and entanglement. | K3 |
| CO 4 | Describe quantum gates, circuits, and models of quantum computation. | K4 |
| CO 5 | Implement basic quantum algorithms using simulators or real quantum hardware. | K4 |
| CO 6 | Evaluate limitations, challenges, and future directions of quantum computing. | K5 |

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

UNIT I

(6 Hours)

Linear Algebra Review – Vector Spaces – Inner Products – Eigenvalues and Eigenvectors – Tensor Products – Complex Hilbert Spaces – Dirac Bra–Ket Notation.

UNIT II

(6 Hours)

Qubits and Quantum States – Superposition – Measurement – Unitary Evolution – Bloch Sphere Representation – Composite Systems – Entanglement.

UNIT III

(6 Hours)

Single-Qubit Gates – Multi-Qubit Gates – Universal Gate Sets – Quantum Circuits – Reversible Computing – Quantum Circuit Model.

UNIT IV

(6 Hours)

Deutsch-Jozsa Algorithm – Grover's Search Algorithm – Shor's Factoring Algorithm – Quantum Fourier Transform – Applications.

UNIT V

(6 Hours)

Quantum Noise and Decoherence – Quantum Error Correction Codes – Fault-Tolerant Computing – Quantum Simulators – IBM Quantum Experience – Quantum Programming Basics (Qiskit) – Current Challenges and Research Trends.

Text Books:

1. Rajiv Pandey, Nidhi Srivastava, Neeraj Kumar Singh, Kanishka Tyagi, "Quantum Computing: A Shift from Bits to Qubits (Studies in Computational Intelligence)", 2023.(Unit – 1,2)
2. Rajendra K. Bera, "The Amazing World of Quantum Computing" 1st ed. 2020. (Unit -3, 4,5)

Reference Books:

1. Shankar, “Quantum mechanics”.2001.
2. Eleanor Rieffel and Wolfgang Polak, “QUANTUM COMPUTING-A Gentle Introduction”, 2011.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc26_ph02/preview
2. https://www.ibm.com/quantum?utm_content=SRCWW
3. <https://github.com/MonitSharma/Learn-Quantum-Computing-For-Free>