# Annexure – I

## CREDIT FRAMEWORK STRUCTURE

| Semester | I | II | III | IV | V | VI | VII | VIII | Total Credits |
|---|---|---|---|---|---|---|---|---|---|
| Basic Science Course (BSC) | 7 | 7 | - | - | - | - | - | - | 14 |
| Engineering Science Course (ESC) | 6 | 6 | - | - | - | - | - | - | 12 |
| Program Core Course (PCC) | | | | | 11 | 9 | 9 | - | 72 |
| Program Elective Course (PEC) | | | | | 3 | 3 | 3 | 3 | |
| Multidisciplinary Minor (MDM) | - | - | 2 | 3 | 3 | 3 | 3 | - | 14 |
| Open Elective (OE) | - | - | - | - | - | 2 | 3 | 3 | 08 |
| Vocations Skill Courses (VSC) | - | - | - | 2 | 2 | - | - | - | 04 |
| Ability Enhancement Course (AEC) | 1 | 1 | - | 3 | - | - | - | - | 05 |
| Indian Knowledge System (IKS) | 2 | - | - | - | - | - | - | - - | 02 |
| Value Education Course (VEC) | - | | 3 | - | - | - | | - | 03 |
| Skill Enhancement Courses (SEC) | 1 | 3 | 1 | 1 | 1 | 1 | - | - | 08 |
| Co-curricular Courses (CC) | 2 | 2 | - | - | - | - | -- | -- | 04 |
| Project work, seminar and internship in industry (ELC) | - | - | 1 | 1 | - | 2 | 2 | 12 | 18 |
| Research Methodology | - | - | - | - | - | - | - | 2 | 02 |
| Total Credits (Major) | 22 | 22 | 22 | 20 | 20 | 20 | 20 | 20 | 166 |

| | | | | |
|---|---|---|---|---|
| | | July 2026 | NEP 2.1 | Applicable for 2024-28 |
| Chairman - BoS | Dean – Academics | Date of Release | Version | |

# ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

## B. Tech. (COMPUTER ENGINEERING) Scheme of Examination & Syllabus 2024-25

## COMPUTER SCIENCE AND ENGINEERING

### SEMESTER V

| Sr. No | Course Category | Course Code | Course Title | Hours per Week | | | Credits | Maximum Marks | | | | Minimum Passing Marks | No. of Hrs for ESE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Mid-Sem Examination | Continual Assessment | End Sem Examination | Total | | |
| 1. | PCC | **24CE501T** | Theory of Computation | **3** | **-** | **-** | **3** | **20** | **20** | **60** | **100** | **45** | **3** |
| 2. | PCC | **24CE502T** | Software Engineering and Project Management | **3** | **-** | **-** | **3** | **20** | **20** | **60** | **100** | **45** | **3** |
| 3. | PCC | **24CE502P** | Software Engineering and Project Management Lab | **-** | **-** | **2** | **1** | **-** | **25** | **25** | **50** | **25** | **-** |
| 4. | PCC | **24CE503T** | Operating System | **3** | **-** | **-** | **3** | **20** | **20** | **60** | **100** | **45** | **3** |
| 5. | PCC | **24CE503P** | Operating System Lab | **-** | **-** | **2** | **1** | **-** | **25** | **25** | **50** | **25** | **-** |
| 6. | PEC | **24CE504T** | Program Elective-I | **3** | **-** | **-** | **3** | **20** | **20** | **60** | **100** | **45** | **3** |
| 7. | VSC | **24CE505P** | Technical Skill Development - II | **-** | **-** | **4** | **2** | **-** | **50** | **-** | **50** | **25** | **-** |
| 8. | SEC | **24CE541P** | Career Development - V | **-** | **-** | **2** | **1** | **-** | **50** | **-** | **50** | **25** | **-** |
| 9. | MDM | **24CE531M** | MDM – III (Refer the Basket) | **3** | **-** | **-** | **3** | **20** | **20** | **60** | **100** | **45** | **3** |
| | | | **Total** | **15** | **-** | **10** | **20** | **100** | **250** | **350** | **700** | - | - |

| **Multidisciplinary Minor – III** | |
|---|---|
| **24CE531M** | **Fundamentals of Data Analytics** |

| **24CE504T** | **Program Elective-I** |
|---|---|
| **24CE504T(i)** | Artificial Intelligence |
| **24CE504T(ii)** | Unstructured Databases |
| **24CE504T(iii)** | Computer Graphics |

| | | | | |
|---|---|---|---|---|
| | | **July 2026** | **NEP 2.1** | **Applicable for 2026-27** |
| **Chairman - BoS** | **Dean – Academics** | **Date of Release** | **Version** | |

| Program Elective-I | |
|---|---|
| 24CE504T(i) | Artificial Intelligence |
| 24CE504T(ii) | Unstructured Databases |
| 24CE504T(iii) | Computer Graphics |
| **Program Elective-II** | |
| 24CE603T(i) | Data Warehousing and Mining |
| 24CE603T(ii) | Mobile Application Programming |
| 24CE603T(iii) | Digital Image Processing |
| **Program Elective-III** | |
| 24CE703T(i) | Deep Learning |
| 24CE703T(ii) | Business Intelligence |
| 24CE703T(iii) | Computer Vision |
| **Program Elective-IV** | |
| 24CE802T(i) | Natural Language Processing |
| 24CE802T(ii) | Cloud Computing |
| 24CE802T(iii) | Blockchain and it's Applications |
| 24CE802T(iv) | Cyber Security and Privacy |

| Open Elective - I | |
|---|---|
| 24CE661OT(i) | Advanced Programming in C |
| 24CE661OT(ii) | Advanced Python Programming |
| 24CE661OT(ii) | Statistical Analysis using R |
| **Open Elective - II** | |
| 24CE761O(i) | Object Oriented Programming in C++ |
| 24CE761O(il) | Data Analytics using Python |
| 24CE761O(lli) | Social Networks |
| **Open Elective - III** | |
| 24CE861O(i) | Cyber Security and Ethics |
| 24CE861O(ii) | Machine Learning |
| 24CE861O(iii) | Data Visualization |

| Course Code | Multidisciplinary Minor |
|---|---|
| 24CE331M | Indian Cyber Law |
| 24CE431M | Essentials of computing Systems |
| 24CE631M | Data Analytics For Decision Making |
| 24CE731M | Advanced Data Analytics |

| | | | | |
|---|---|---|---|---|
| | | July 2026 | NEP 2.1 | Applicable for 2027-28 |
| Chairman - BoS | Dean – Academics | Date of Release | Version | |

## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | MSE | CA | ESE | Total |
| 24CE501T | Theory of Computation | 3 | - | - | 3 | 20 | 20 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| **This course is intended**<br>1. To study the theoretical foundation of finite state machines and its application.<br>2. To study formal languages and related grammar.<br>3. To study basic computational function related to automaton. | **Students will be able to**<br>1. Design the Finite State Machine with mathematical representation.<br>2. Analyze regular languages and grammars using automata concepts.<br>3. Construct CFGs and PDAs for context free languages.<br>4. Analyze real-world computational problems using Turing machines for computability and decidability.<br>5. Compare recursive functions and complexity classes for efficient problem solving. |

| | |
|---|---|
| **Unit I** | **[9Hrs]** |
| Strings, Alphabet, Language operations, Finite state machine definitions, Finite automation model, Acceptance of strings and language, Non deterministic finite automation, Deterministic finite automation, Equivalence between NFA and DFA, Conversion of NFA into DFA, Moore and Mealy machines. Applications of Finite Automata | |
| **Unit II** | **[9Hrs]** |
| Regular sets, Regular expressions, Identity Rule, Manipulation of regular expressions, Equivalence between RE and FA, Inter conversion, Pumping lemma, Closure properties of regular sets(proofs not required), Chomsky hierarchy of languages, Regular grammars, Right linear and left linear grammars, Equivalence between regular grammar and finite automation | |
| **Unit III** | **[9Hrs]** |
| Context free grammar, Derivation trees (Syntax tree and Parse tree), Ambiguous Grammar, Simplification of CFG, Context Free Language (CFL), Closure properties of CFL, Normal Form of grammar: Chomsky Normal form, Greibach normal form, Push Down Automaton, Acceptance by Final State and Empty Stack, Equivalence of PDA and CFG | |
| **Unit IV** | **[9Hrs]** |
| Turing Machine: Definition, Model of TM, Design of TM, Universal Turing Machine, Types of TM's (proofs not required), Turing Computable Functions, Linear bounded automaton, Church-Turing Thesis, Decidability and Undecidability of problems, Properties of recursive & recursively enumerable languages, Halting problem of TM | |
| **Unit V** | **[9Hrs]** |
| Post correspondence problem, Recursive Function: Basic functions and operations on them ,Ackerman function, Primitive recursive function, μ-recursive function, Time Complexity Basics, Complexity Classes: P,NP, NP-Complete, NP-Hard | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Theory of Computer Science, Automata, Languages and Computation | K. L. P. Mishra and N. Chandrasekaran | 3rd Edition | PHI Learning. |
| 2 | Introduction to Automata Theory, Languages and Computation | J. E. Hopcraft,R. Motwani, J. D Ullman | 2nd Edition | Pearson Education, Aisa |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Introduction to Theory of Computation | Sipser | 2nd Edition | Cengage publications |
| 2 | An Introduction to Formal Languages and Automata | Peter Linz | 6th Edition | Jones & Bartlett Learning |
| 3 | Introduction to Languages and the theory of Automata | John Martin | 3rd Edition | TMH Publication |

## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | MSE | CA | ESE | Total |
| 24CE502T | Software Engineering and Project Management | 3 | - | - | 3 | 20 | 20 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| **This course is intended**<br>1. To provide understanding of software engineering principles<br>2. To enable students to understand stages involved in the development of software project<br>3. To get acquainted with software quality, reliability and software configuration management. | **Students will be able to**<br>1. Distinguish and apply software development techniques to the different kinds.<br>2. Analyze project requirements and author a formal specification for a software system.<br>3. Apply design process, steps for effective UI design depending on the requirement of the project.<br>4. Design test cases, apply testing strategies and demonstrate the ability to plan, estimate project.<br>5. Demonstrate the ability to work on software project by taking into consideration software quality factors. |

| **Unit I** | **[9 Hrs]** |
|---|---|
| What is Software? Role of Software Engineer, software development phases Process Models: Waterfall Model, Prototype model Incremental model, Spiral Model, Agile process: Scrum, Extreme programming. | |
| **Unit II** | **[9 Hrs]** |
| Requirements Engineering: Initiating the process, Eliciting Requirements, Building the Requirements Model, Negotiating, Validating requirements, Requirements Analysis, Scenario-Based Analysis, Requirements Modeling strategies, Flow-Oriented Modeling, Class based modeling, SRS. | |
| **Unit III** | **[9 Hrs]** |
| Design: What is Design? Design Principles, Effective modular design, Design models: Data, Architectural Design. User Interface Design: Rules, User Interface Analysis and Design. | |
| **Unit IV** | **[9 Hrs]** |
| Software Testing: Testing Fundamentals, White Box Testing, Black Box Testing, Unit Testing, Integration Testing. Validation Testing, Debugging. Estimation for Software Projects: Project Planning objectives, Software Scope, Feasibility. | |
| **Unit V** | **[9 Hrs]** |
| Software Quality Assurance: Concepts, Approaches, Software Quality Factor, Software Reviews, Software Reliability. Software Configuration Management. | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Software Engineering, A practitioner's approach | Roger Pressman | 7th Edition | Tata Mcgraw Hill |
| 2 | Object Oriented Software Engineering Using UML Patterns and Java | Bernd Bruegge &Allen H. Dutoit. | 2nd Edition | PHI |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | OOA and Design | Grady Booch | 2nd Edition | Ad. Wesly |
| 2 | OO Modeling and Design with UML | James Rambhaugh | 2nd Edition | PHI |

## FIFTH SEMESTER

| CourseCode | CourseName | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 24CE502P | Software Engineering and Project Management Lab | - | - | 2 | 1 | 25 | 25 | 50 |

| Course Objectives | Course Outcomes |
|---|---|
| This course is intended<br>1. To provide understanding of principles of software engineering.<br>2. To enable students to understand stages involved in the development of software project. | **Students will be able to**<br>1. Analyze project requirements, and author a formal specification for a software system.<br>2. Demonstrate the ability to plan, estimate and schedule project.<br>3. Apply design process depending on the requirement of the project.<br>4. Design test cases and apply testing strategies in software development. |

| Expt.No. | Title of the experiment |
|---|---|
| | Identify a real-world software problem statement use the same case study throughout the Software Engineering and Project Management practical course. |
| 1. | identifying the Requirements from Problem Statements and author specification document<br>Requirements \| Categorization of Requirements \| Functional Requirements \| Non-Functional Requirements \| Other Requirements |
| 2. | Estimation of Project Metrics<br>Project Estimation Technique\| COCOMO Model \|Project cost estimation |
| 3. | Scheduling Project<br>Identifying Tasks \| Identifying Resources \| Schedule Project Use GANTT chart with Agile sprint planning concepts. |
| 4. | Modeling UML Use Case Diagrams and Capturing Use Case Scenarios Identifying<br>Identifying Actors \| Identifying Use cases \| Draw Use Case diagrams |
| 5. | Modeling Data Flow Diagram<br>Draw Data Flow Diagram Level 0 \| Level 1 \| Level 2 |
| 6. | Modeling UML Class Diagrams<br>Structural and Behavioral aspects \| Class diagram \| Elements in class diagram \| Class \| Relationships \| Draw Class Diagram |
| 7. | Modeling Sequence Diagrams<br>Sequence diagram \| Elements in sequence diagram \| Object \| Life-line bar \| Messages \| Draw Sequence Diagram |
| 8. | Designing Test Suites Software Testing \| Need for Software Testing \|Types of Software Testing\| Design Test Suites |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Software Engineering, A practitioner's approach | Roger Pressman | 7th Edition | Tata Mcgraw Hill |
| 2 | Object Oriented Software Engineering Using UML Patterns and Java | Bernd Bruegge & Allen H. Dutoit. | 2nd Edition, | PHI |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | OOA and Design | Grady Booch | 2nd Edition | Ad. Wesly |
| 2 | OO Modeling and Design with UML | James Rambhaugh | 2nd Edition | PHI |

| | | | | |
|---|---|---|---|---|
| | | July 2026 | NEP 2.1 | Applicable for 2026-27 |
| Chairman - BoS | Dean – Academics | Date of Release | Version | |

## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | MSE | CA | ESE | Total |
| 24CE503T | Operating System | 3 | - | - | 3 | 20 | 20 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| This course is intended<br>1. To introduce the fundamental concepts and functions of Operating Systems.<br>2. To demonstrate the notion of processes, process management, and CPU scheduling algorithms.<br>3. To examine classical process synchronization problems and their solutions.<br>4. To analyze memory management techniques, including paging, virtual memory management, and page replacement algorithms.<br>5. To explore disk management and File System techniques. | Students will be able to<br>1. Illustrate the fundamental concepts, structure, and functions of operating systems.<br>2. Demonstrate process management and CPU scheduling algorithms used in operating systems.<br>3. Apply synchronization techniques to solve classical process synchronization problems.<br>4. Analyze memory management techniques, including paging, segmentation, and virtual memory concepts.<br>5. Interpret disk management and file system Basic. |

| **Unit I** | **[9Hrs]** |
|---|---|
| **Operating Systems** – Definition, Types and Functions – Abstract View of OS – Booting Process and Bootstrap Program – System Calls and Types of System Calls – **Virtual Machines** – Cloud Operating Environment – Difference between Traditional OS, Virtual Machines and Containers. | |
| **Unit II** | **[9Hrs]** |
| **Process Concept** – Process Definition – Operations on Processes – Process States – Process Control Block (PCB) – Context Switching – Process Scheduling – Scheduling Objectives – Types of Schedulers – CPU Scheduling Algorithms: FCFS, SJF, Priority and Round Robin Scheduling – **Threads and Multithreading Concepts** – Introduction to Multicore Processing and Multithreaded Applications. | |
| **Unit III** | **[9Hrs]** |
| **Synchronization** – Critical Section Problem – Race Condition – Semaphores – Mutex Locks – Producer Consumer Problem – Reader Writer Problem – Synchronization in Multicore Systems and Concurrent Processing. **Deadlocks** – System Model – Deadlock Characterization – Deadlock Prevention – Deadlock Avoidance using Banker's Algorithm – Deadlock Detection and Recovery. | |
| **Unit IV** | **[9Hrs]** |
| **Memory Management:** Basic concepts, logical and physical address mapping**,** Swapping **Memory Allocation** -Contiguous Memory Allocation - fixed partition and Variable partition, **Fragmentation :** Internal and External Fragmentation, Paging concept **Virtual memory Management** –Demand Paging- Page Replacement Algorithm : FIFO, LRU, Optimal | |
| **Unit V** | **[9Hrs]** |
| **Disk Management:** Disk Structure, Disk Scheduling – FCFS, SSTF, SCAN **File System:** File concept, File attributes, File operations, File Types. File Access Method : Sequential Access, Direct access, Virtualization and Cloud Operating Environment **Case Study**: Windows OS, Linux File Systems and Android OS , Resource management in mobile OS | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Operating System Concepts | A.Silberschatz,Peter B. Galvin,Grag Gagne | 8th edition | John Wiley & Sons, Inc. (Wiley). |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Operating System | A.Godbole, Atul Kahate | 3rd Edition | Tata McGrawHill |
| 2 | Operating Systems Concepts and Design | Milan Milenkovic | 7th Edition | Tata McGrawHill |

## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 24CE503P | Operating System Lab | - | - | 2 | 1 | 25 | 25 | 50 |

| Course Objectives | Course Outcomes |
|---|---|
| **This course is intended**<br>1. To provide practical knowledge of operating system concepts using Linux environment and C programming.<br>2. To develop programs related to process management, CPU scheduling, synchronization, memory management, and deadlock handling.<br>3. To analyze and implement operating system algorithms and resource management techniques. | **Students will be able to**<br>1. Implement basic operating system services and functionalities using Linux/UNIX system calls.<br>2. Analyze and implement CPU scheduling algorithms such as FCFS, SJF, Priority, and Round Robin.<br>3. Apply and analyze memory management and page replacement techniques in operating systems.<br>4. Develop process synchronization mechanisms to solve concurrent access problems.<br>5. Evaluate deadlock handling and avoidance techniques in multiprogramming systems. |

| Expt. No. | Title of the experiment |
|---|---|
| 1 | Demonstrate Linux Commands and Shell Environment Operations. |
| 2 | Implement System Calls using C (fork(), exec(), wait()). |
| 3 | Implement FCFS CPU Scheduling Algorithm |
| 4 | Implement Round Robin CPU Scheduling Algorithm and analyze performance using OS Virtual lab |
| 5 | Implement synchronization problems using Producer–Consumer model. Using OS virtual Lab |
| 6 | Implement Banker's Algorithm for Deadlock Avoidance using GitHub Environment and GitHub Repository |
| 7 | Implement Memory Allocation Techniques using Fixed and Variable Partitioning |
| 8 | Implementation of Containerized Cloud Operating Environment using Docker or Virtual Machines. |
| 9 | Mini Project -Design and Develop an Operating System Algorithm Visualizer |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Operating System | A. Godbole | 3rd Edition | The McGraw-Hill. |
| 2 | Operating System Concepts | A.Silberschatz,Peter B. Galvin,Grag Gagne | 8th edition | John Wiley & Sons, Inc. (Wiley). |

## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 24CE504T(i) | PE-I Artificial Intelligence | 3 | - | - | 3 | 30 | 70 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| This course is intended<br>1. To understand AI concepts, intelligent agents, and search techniques.<br>2. To learn knowledge representation, reasoning, and machine learning methods.<br>3. To apply NLP, Expert Systems, and Generative AI for real-world applications. | At the end of the Course, the Student will be able to:<br>1. Describe intelligent agents and search strategies used in Artificial Intelligence.<br>2. Interpret knowledge representation and inference techniques in AI systems.<br>3. Examine probabilistic reasoning and AI planning models for decision-making.<br>4. Implement machine learning and intelligent learning methods for problem-solving.<br>5. Assess NLP, Expert Systems, and Generative AI applications in industry domains. |

| **Unit I** | **[9Hrs]** |
|---|---|
| **Introduction to Artificial Intelligence**, History and evolution of AI, Applications of AI in IT industries, Current trends in AI including Generative AI and Explainable AI, Intelligent agents and types of agents, Problem solving in AI, Uninformed search techniques: Breadth First Search (BFS), Depth First Search (DFS), Informed search techniques: Best First Search and A* algorithm, Adversarial search, Min-Max algorithm, Alpha-Beta pruning. | |
| **Unit II** | **[9Hrs]** |
| **Knowledge Representation and Reasoning:** Knowledge representation in AI, Types of knowledge, Knowledge representation techniques, Propositional logic, Predicate logic, Syntax and inference mechanisms, Semantic networks, Frames, Rule-based systems, Inference engines, Knowledge representation issues, Introduction to ontology and knowledge graphs. | |
| **Unit III** | **[9Hrs]** |
| **Reasoning Under Uncertainty and Planning:** Basics of probability theory, Reasoning under uncertainty, Bayesian reasoning and Bayesian networks, Dempster-Shafer Theory (DST), Decision making under uncertainty, AI planning concepts, State space search, Goal-based planning, Block world problem, Partial-order planning, Applications in intelligent decision systems. | |
| **Unit IV :** | **[9Hrs]** |
| **Machine Learning and Intelligent Learning Systems**: Introduction to machine learning, Types of learning: Supervised, Unsupervised and Reinforcement learning, Rote learning, Symbol-based learning, Explanation-based learning, Identification trees and decision trees, Transformational analogy, Basics of AI model evaluation, Ethical and responsible AI concepts. | |
| **Unit V** | **[9Hrs]** |
| **AI APPLICATIONS:** Natural Language Processing (NLP), Information retrieval, Information extraction, Conversational AI and chatbots, Expert systems and phases in building expert systems, Introduction to Generative AI and Large Language Models (LLMs), Prompt engineering basics, AI tools and industry applications. | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Artificial Intelligence: A Modern Approach | Stuart R. &Peter Norvig | 2nd Edition | Pearson Education |
| 2 | Generative AI on AWS | Chris Fregly and Antje Barth | 1st Edition | O'Reilly Media |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | The Art of Prompt Engineering with ChatGPT | Nathan Hunter | 4th Edition | Shroff/Hunter. |
| 2 | Speech and Language Processing | Daniel Jurafsky and James H. Martin | 3rd Edition | Pearson |

## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | MSE | CA | ESE | Total |
| 24CE504T(ii) | PE-I Advanced Database Management Systems | 3 | - | - | 3 | 20 | 20 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| **This course is intended**<br>1. To impart knowledge of advanced query processing, concurrency control and distributed databases.<br>2. To familiarise students with NoSQL, cloud and big data platforms.<br>3. To develop the ability to select suitable databases for AI-era applications. | **Students will be able to**<br>1. Explain query plans and the working of MVCC and SQL isolation levels.<br>2. Interpret how replication, sharding and the CAP/PACELC theorem influence the design of distributed databases.<br>3. Apply NoSQL and cloud database concepts to select a suitable platform for a given application.<br>4. Demonstrate the use of data lake, warehouse, lakehouse architectures and columnar storage for real time applications.<br>5. Implement graph and vector database concepts to support AI-driven applications. |

| **Unit I** | **[9 Hrs]** |
|---|---|
| **Query Processing and Concurrency Control:** Query processing pipeline — parsing, optimisation, execution. Cost-based query optimisation at a conceptual level. Introduction to query plans — EXPLAIN in PostgreSQL; sequential scan vs index scan. Multi-Version Concurrency Control (MVCC) — basic idea and its use in PostgreSQL. SQL isolation levels — READ COMMITTED, REPEATABLE READ, SERIALIZABLE — and the anomalies they prevent. Recovery basics — Write-Ahead Logging (WAL) and checkpoints. | |
| **Unit II** | **[9 Hrs]** |
| **Distributed Databases:** Motivation for distributing a database — scale, availability, geography. Replication — leader-follower replication; synchronous vs asynchronous. Sharding (partitioning) — range-based and hash-based with examples. CAP theorem and BASE properties revisited; introduction to PACELC. Distributed transactions — Two-Phase Commit (2PC) and its limitations. Brief overview of NewSQL — Google Spanner and CockroachDB. | |
| **Unit III** | **[9 Hrs]** |
| **NoSQL and Cloud Databases:** Recap of NoSQL families — Key-Value, Document, Column-Family, Graph. MongoDB at a working level — document model, basic queries and aggregation. Cloud databases — managed database services; Amazon RDS and Google Cloud SQL as examples. Database as a Service (DBaaS) — benefits and limitations. Choosing between SQL and NoSQL for an application — a decision-oriented discussion with examples. | |
| **Unit IV** | **[9 Hrs]** |
| **Big Data and Analytical Platforms:** Need for big data systems — volume, velocity, variety. Data lake vs data warehouse vs lakehouse — explained with a diagram. Columnar storage — Parquet file format at a conceptual level; why columnar is faster for analytics. Introduction to analytical platforms — Snowflake and Google BigQuery. Introduction to stream processing — Apache Kafka as a distributed log; windowing (tumbling and sliding) at a basic level. | |
| **Unit V** | **[9 Hrs]** |
| **Graph, Vector and AI-Era Databases:** Graph databases — property graph model; basic Cypher queries (Neo4j); use cases. Vector databases — embeddings and similarity search; Approximate Nearest Neighbour (ANN) at a conceptual level. PostgreSQL pgvector — using a relational database for vector search. Retrieval-Augmented Generation (RAG) — how vector databases support LLM applications. A look ahead — in-database machine learning with BigQuery ML (concept only). | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1. | Database System Concepts | Korth, Silberschatz, Sudarshan | 7th | McGraw Hill |
| 2. | Designing Data-Intensive Applications | Martin Kleppmann | 2nd | O'Reilly |
| 3. | Database Management Systems | Ramakrishnan, Gehrke | 3rd | McGraw Hill |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1. | Seven Databases in Seven Weeks | Luc Perkins, Eric Redmond | 2nd | Pragmatic Bookshelf |
| 2. | Next Generation Databases | Guy Harrison | 2nd | Apress |
| 3. | Graph Databases | Robinson, Webber, Eifrem | 2nd | O'Reilly |

## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | MSE | CA | ESE | Total |
| 24CE504T(iii) | PE – I Computer Graphics | 3 | - | - | 3 | 20 | 20 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| This course is intended<br>1. To understand the fundamental concepts, techniques, and applications of Computer Graphics.<br>2. To study geometric transformations, rendering techniques, and advanced concepts used in computer graphics systems. | Students will be able to<br>1. Explain computer graphics fundamentals and drawing algorithms.<br>2. Apply 2D transformations and clipping techniques. for graphical object representation.<br>3. Illustrate 3D transformations and projection methods..<br>4. Analyze colour models and illumination techniques.<br>5. Differentiate hidden surface removal and shading techniques used in realistic image generation. |

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| **Unit I** | **[9 Hrs]** |
| **Fundamentals of Computer Graphics :-**<br>Overview of graphics systems – Video display devices, Raster scan systems, Input devices, Pixel and Resolution, Graphics Rendering Pipeline, Graphics Software; Frame Buffer Concept, Output primitives – points and lines, line drawing algorithms, circle generating algorithms. | |
| **Unit II** | **[9 Hrs]** |
| **Two Dimensional Transformations and Clipping :-**<br>Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Window-to-Viewport Transformation; clipping operations – point, line, and polygon clipping algorithms | |
| **Unit III** | **[9 Hrs]** |
| **Three Dimensional Graphics and Projections:-**<br>Three dimensional concepts and transformations; Three dimensional object representations using polygon surfaces and polygon meshes; Curved lines and surfaces – Bezier curves and B-Spline curves; Parallel and Perspective projections. | |
| **Unit IV** | **[9 Hrs]** |
| **Colour Models and Illumination**:-<br>Light sources and basic illumination models, Halftoning and dithering techniques, Properties of light and chromaticity diagram, Colour models – RGB, CMY/CMYK, HSV and RGBA, Colour selection and transparency concepts. | |
| **Unit V** | **[9 Hrs]** |
| **Visible Surface Detection and Shading Techniques:-**<br>Hidden line and surface removal techniques – Back Face Detection, Depth Buffer method, A-Buffer method and Scan Line method; Illumination and shading models – Ambient, Diffuse and Specular reflection, Phong illumination model, Introduction to OpenGL/WebGL, Graphics Rendering Pipeline, Graphics API Basics, Animation Basics | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Computer Graphics: Principles and Practice | John F. Hughes, Andries Van Dam, Morgan Mcuire ,David F. Sklar , James D. Foley, Steven K. Feiner | 3rd Edition | Addison- Wesley Professional,2013 |
| 2 | Computer Graphics with OpenGL | Donald Hearn and M. Pauline Baker | 4th Edition | Prentice Hall, New Delhi |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Fundamentals of Computer Graphics | Peter Shirley, Michael Ashikhmin, Steve Marschner | 5th Edition | CRC Press, 2021 |
| 2 | Interactive Computer Graphics: A Top-Down Approach with OpenGL | Edward Angel, Dave Shreiner | 6th Edition | Pearson Education, 2015 |
| 3 | Procedural Elements for Computer Graphics | David F. Rogers | 2nd Edition | McGraw-Hill International |
| 4 | Fundamentals of Computer graphics & Multimedia | Mukherjee | 2nd Edition | PHI Learning Private Ltd |

## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 24CE541P | Career Development – V | - | - | 2 | 1 | 50 | - | 50 |

| Course Objectives | Course Outcomes |
|---|---|
| To enhance students' aptitude, analytical reasoning, communication, teamwork, and professional presentation skills required for competitive examinations, higher education, and workplace success. | **CO1.** Students will be able to solve problems related to time and work, pipe and cisterns, geometry, mensuration, and analytical puzzles using logical and quantitative reasoning skills.<br>**CO2.** Students will be able to apply concepts of time, speed, and distance and solve coding-decoding and direction sense problems accurately using analytical thinking.<br>**CO3.** Students will be able to perform SWOC analysis, set SMART goals, and deliver effective self-introductions with confidence and professional communication skills.<br>**CO4** Students will be able to conduct company profile presentations and participate effectively in table topic group discussions demonstrating teamwork, critical thinking, and spontaneous speaking skills.<br>**CO5.** Students will be able to demonstrate improved verbal ability, grammar, vocabulary, reading comprehension, and active classroom participation for professional communication. |

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| **Unit I (15marks)** | **[7Hrs]** |
| Time and Work, Chain Rule, Pipe and Cistern, Geometry and mensuration<br>**Puzzles:-** Analytical puzzle, Tabular Puzzle, Box or Floor based Puzzle, Rank based Puzzle | |
| **Unit II (10marks)** | **[7Hrs]** |
| **Time Speed and Distance:-** Basic Problems, Average Speed, Relative Speed, Problems on Trains, Boats and Streams, Escalators, Directions sense Problems<br>Coding and Decoding | |
| **Unit III (5marks)** | **[5Hrs]** |
| **SWOC Analysis and SMART Goal Setting** - for Personal and Professional Development<br>**Self-Elevator Pitch –** Self Introduction, Confidence Building, and Professional Communication Skills (5marks) | |
| **Unit IV (10marks)** | **[6Hrs]** |
| **Company Profile Group Presentation –** Research, Team Coordination, and Presentation Techniques (5marks)<br>**Table Topic Group Discussion –** Critical Thinking, Spontaneous Speaking, and Team Interaction | |
| **Unit V (10marks)** | **[3Hrs]** |
| **Verbal Ability Quiz –** Grammar, Vocabulary Building, and Reading Comprehension for Professional Communication<br>**Continuous Assessment -** Attendance, Individual Engagement & Team Dynamics | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Quantitative Aptitude By R. S. Aggarwal | R.S. Aggarwal | | |
| 2 | Quantitative Aptitude | Shripad Deo | | Allied Publication |
| 3 | A Modern Approach to Verbal & Non-Verbal Reasoning | R.S. Aggarwal | | |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Quantitative Aptitude for CAT by Arun Sharma | Arun Sharma | | |
| 2 | Developing Communication Skills | Krishna Mohan & Meera Banerji | 2002 | |
| 3 | Professional Communication Skills | Alok Jain | 2006 | S Chand & Company Ltd. |
| 4 | Personality Development & Soft Skills | Barun Mitra | 2019 | Cambridge University Oress |

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|---|---|---|---|---|
| | | July 2026 | NEP 3.0 | Applicable for 2026-27 |
| Chairman - BoS | Dean – Academics | Date of Release | Version | |

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## FIFTH SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 25CE531M | Fundamentals of Data Analytics | 3 | - | - | 3 | 40 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| **This course is intended to**<br>1. Introduce core concepts of data and analytics<br>2. Develop a basic statistical understanding for data analysis<br>3. Provide foundational programming skills for data handling<br>4. Explain data collection and pre-processing techniques<br>5. Enable basic data analysis and visualization | **Students will be able to**<br>1. Explain core concepts of data and analytics<br>2. Compute and interpret basic statistical measures<br>3. Use programming tools for basic data handling<br>4. Apply data pre-processing techniques on datasets<br>5. Perform exploratory analysis and visualize data |

**Unit I: Data Literacy and Analytical Thinking** **[8 Hrs]**

Data, information, and knowledge: definitions and distinctions, Role of data in engineering, business, healthcare, and social systems, Types of data: structured, semi-structured, unstructured, Types of analytics: descriptive, diagnostic, predictive, prescriptive (overview), Data analytics lifecycle, Translating real-world problems into analytical questions, Case examples from multidisciplinary domains.

**Unit II: Statistical Foundations and Data Representation** **[10 Hrs]**

Types of variables and measurement scales, Measures of central tendency: mean, median, mode, Measures of dispersion: range, variance, standard deviation, Introduction to data distributions, Basics of probability (events, simple probability), Correlation and covariance (conceptual); correlation vs causation, Data representation: Basic data structures (lists, arrays, tables), Tabular data formats, Reading datasets (CSV/Excel) using programming tools, Basic data inspection and summary.

**Unit III: Data Acquisition and Initial Handling** **[8 Hrs]**

Data sources: databases, web data, sensors, and open datasets. Data formats: CSV, Excel, JSON, Data collection methods, Dataset import and file handling using Python/R, Dataset structure: rows, columns, attributes. Data selection and filtering, Introduction to tabular data structures (DataFrames).

**Unit IV: Data Preprocessing and Transformation** **[10 Hrs]**

Data quality issues: missing data, noisy data, inconsistent data. Handling missing values: deletion, mean/mode imputation. Data cleaning: duplicate removal, inconsistency correction, Data transformation: Normalization and scaling. Categorical encoding (basic methods), Implementation of preprocessing using programming tools.

**Unit V: Exploratory Data Analysis and Visualization** **[9 Hrs]**

Purpose of Exploratory Data Analysis (EDA), Data summarization: tables and descriptive statistics, Visualization techniques: bar charts, histograms, scatter plots, Pattern, trend, and anomaly identification, Correlation analysis using plots, Visualization using programming tools, Principles of effective visualization, Data interpretation and storytelling.

**Text Books/ Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Data Analytics Made Accessible | Anil Maheshwari | 2nd | McGraw-Hill Education |
| 2 | Python for Data Analysis | Wes McKinney | 3rd | O'Reilly Media |
| 3 | Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python | Peter Bruce, Andrew Bruce, Peter Gedeck | 2nd | O'Reilly Media |
| 4 | Think Stats: Probability and Statistics for Programmers | Allen B. Downey | 2nd | O'Reilly Media |
| 5 | Data Science from Scratch: First Principles with Python | Joel Grus | 2nd | O'Reilly Media |