# COURSE STRUCTURE

## *For*

# B.TECH. DEGREE

## *in*

# COMPUTER SCIENCE & ENGINEERING

*(Applicable from the academic session 2024-2025)*

**Dr. B. C. Roy Engineering College**

***An Autonomous Institution***

***Approved by: All India Council for Technical Education (AICTE)***
***Affiliated to: Maulana Abul Kalam Azad University of Technology, West Bengal***
***(Formerly Known as -WBUT)***

**Jemua Road, Durgapur, West Bengal, India, 713206**

• The first year course structure (Page 3 and Page 4) is unanimously accepted and approved in the first BoS meeting held in the Department of a) Physics, b) Chemistry, c) Mathematics, d) English, e) Electrical Engineering, f) Electronics and Communication Engineering, g) Computer Science and Engineering, h) Mechanical Engineering.

• The BoS of CSE (Computer Science and Engineering) in its first meeting (held in the Department of CSE (Computer Science and Engineering) on 6th November 2024 has unanimously accepted and approved the four year course structure of CSE (Computer Science and Engineering).

Head
Dept. Computer Science & Eng
Dr. B. C. Roy Engineering College
Durgapur

| Semester 5 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sl No** | **Course Type** | **Paper Code** | **Paper Name** | **Marks** | **L** | **T** | **P** | **Credit** |
| ***Theory*** | | | | | | | | |
| 1 | PC | CS-501 | Operating System | 100 | 3 | 0 | 0 | 3 |
| 2 | PC | CS-502 | Software Engineering | 100 | 3 | 0 | 0 | 3 |
| 3 | PC | CS-503 | Compiler Design | 100 | 3 | 0 | 0 | 3 |
| 4 | PC | CS-504 | Artificial Intelligence | 100 | 3 | 0 | 0 | 3 |
| 5 | PE | CS505-514 | Core Elective I: Data Mining / Computer Graphics / Advanced Computer Architecture / Distributed Database Management System | 100 | 3 | 0 | 0 | 3 |
| 6 | OE | CS515-524 | Open Elective I: Linear Algebra & Numerical Methods / Economics for Engineers / Multimedia Sysytem / Augmented & Virtual Reality | 100 | 3 | 0 | 0 | 3 |
| | | | Total Theory | 600 | 18 | 0 | 0 | 18 |
| ***Practical*** | | | | | | | | |
| 7 | PC | CS591 | Operating System Lab | 100 | 0 | 0 | 4 | 2 |
| 8 | PC | CS592 | Software Engineering Lab | 100 | 0 | 0 | 4 | 2 |
| | | | Total Practical | 200 | 0 | 0 | 8 | 4 |
| | | | Total of 5th Semester | 800 | 18 | 0 | 8 | 22 |
| **Total Credits** | | | | | | | | **22** |

**Course Name:** Operating Systems
**Course Code:** CS501
**(Semester- V)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

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1. **Course Prerequisite:**
   Computer Architecture, Computer Organization
   **Course Learning Objectives:**
   1 To learn the mechanisms of OS to handle processes and threads and their communication.
   2 To learn the mechanisms involved in memory management.
   3 To gain knowledge on process synchronization.
   4. To learn about deadlock, memory management, and file management.

   **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –** Lectures and Presentations, Interactive Discussions, and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
2. **Course Content**
   **Course Name:** Operating Systems
   **Course Code:** CS501
   **Hours per Week:**3L
   **Credits: 3**

| Module | Topics | Lectures |
|---|---|---|
| 1 | Introduction: Generations Concept of Operating systems, Systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System. | 3 |
| 2 | Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive algorithms (FCFS, SJF, SRTF, RR) | 10 |
| 3 | Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem. | 5 |

| | | |
|---|---|---|
| 4 | Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery. | 5 |
| 5 | Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation –Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Least Recently Used (LRU) | 8 |
| 6 | **I/O, Disc and File management**: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks. | 6 |

## 6. References:

**Text & References Books:**


1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, WilliamStallings, Prentice Hall of India.
3. Operating System Concepts, Ekta Walia, Khanna Publishing House (AICTE Recommended Textbook – 2018)
4. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
5. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, AddisonWesley
6. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
7. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, MarcoCesati, O'Reilly and Associates


## 7. Course Outcomes:

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **CO1** | Understand the necessity, development, numerous classification, and design issues of the operating system. | Understand | L2 |

| | | | |
|---|---|---|---|
| **CO2** | Apply different methods for implementing processes and threads as well as the various process scheduling algorithms. | Apply | L3 |
| **CO3** | Identify different challenges associated with deadlock, concurrency, and different synchronization mechanisms | Identify | L1 |
| **CO4** | Analyze several memory management strategies for memory allocations and implementation of virtual | Analyze | L4 |
| **CO5** | Understand I/O management, disc management, and file system structure. | Understand | L2 |

## 8. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| 1 | 3 | - | - | - | - |
| 2 | - | 3 | - | - | - |
| 3 | - | - | 3 | - | - |
| 4 | - | - | 3 | - | - |
| 5 | - | - | - | 3 | - |
| 6 | - | - | - | - | 3 |

## 9. Mapping of the Course outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | **1** | | | | | | | | | | **3** |
| **CO2** | **2** | **3** | **3** | **1** | | | | | | | | **3** |
| **CO3** | **3** | **3** | **3** | **2** | | | | | | | | **3** |
| **CO4** | **2** | **3** | **3** | **2** | | | | | | | | **3** |
| **CO5** | **2** | **3** | **3** | **2** | | | | | | | | **3** |
| **AVG.** | **2.4** | **2.6** | **3** | **1.75** | | | | | | | | **3** |

## 10. Mapping to PSO

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | 3 | 1 | - | - |
| **CO2** | 3 | 2 | 2 | 1 |
| **CO3** | 3 | 3 | 2 | 1 |
| **CO4** | 3 | 3 | 2 | 1 |
| **CO5** | 3 | 3 | - | - |

***** End of Syllabus*****

**Course Name:** Software Engineering
**Course Code:** CS-502
**(Semester-V)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

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1. **Course Prerequisite:**

2. **Course Learning Objectives:**
3. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –** Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   **Course Name:** Software Engineering
   **Course Code:** CS-502
   **Hours per Week:** 3L: 0T: 0P
   **Credits:** 3

| Module | Topics | Lectures |
|---|---|---|
| 1 | Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, COCOMO model. [10L] | 10 |
| 2 | System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object-Oriented approach. [5L] | 5 |
| 3 | Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. [4L] Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & VerificationMetrics, Monitoring & Control. [8L] | 12 |
| 4 | Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. [7L] | 7 |
| 5 | Static and dynamic models, why modeling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram. [10 L] | 10 |

6. **References:**

**Text & References Books:**

1. Pressman, Software Engineering : A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. N.S. Gill, Software Engineering – (Khanna Publishing House)
4. Rajib Mall, Software Engineering- (PHI)
5. Agarwal and Agarwal, Software Engineering – (PHI)
6. Sommerville, Software Engineering – Pearson
7. Martin L. Shooman, Software Engineering – TMH

## 7. Course Outcomes:

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **1** | Understanding and applying various software development methodologies (e.g., Agile, Waterfall) while navigating through all stages of the Software Development Life Cycle, including planning, design, development, testing, deployment, and maintenance. | Understand | L2 |
| **2** | Developing the skills to gather, analyze, and document both functional and non-functional requirements from stakeholders and translate them into clear system specifications for development | Apply | L3 |
| **3** | Gaining the knowledge to design scalable, maintainable, and efficient software architectures, and apply design patterns and best practices to develop high-quality software systems | Understand | L2 |
| **4** | Being able to design and implement various software testing strategies (e.g., unit testing, integration testing) to ensure that the software meets the desired quality, functionality, and performance standards | Identify | L1 |
| **5** | The ability to work effectively in software development teams, using industry-standard tools like version control (Git), and managing projects using Agile or Scrum methodologies to deliver software on time and within budget. | Analyze | L4 |
| **6** | Gaining hands-on experience in programming with multiple programming languages | Apply | L3 |
| **7** | Understanding security principles in software development, including secure coding practices, and being aware of ethical considerations and professional responsibilities, ensuring that their software solutions are secure and align with legal and ethical standards | Understand | L2 |

## 8. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | 3 | - | - | - | - | - |
| 2 | - | 3 | - | - | - | - |
| 3 | - | - | 3 | - | - | - |
| 4 | - | - | - | 3 | - | - |
| 5 | - | - | - | - | 3 | - |
| 6 | - | 3 | - | - | - | - |
| 7 | - | - | - | - | - | 3 |

## 9. Mapping of the Course outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 3 | - | 2 | - | - | - | - | - | - | - | - |
| **CO3** | 3 | - | 2 | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | - | - | 2 | 2 | - | - | - | - | - |
| **CO5** | - | 3 | - | - | 3 | - | - | - | - | - | - | - |
| **CO6** | - | - | - | - | - | - | - | - | 3 | - | - | 3 |
| **AVG.** | **1.0** | **1.33** | **0.33** | **0.33** | **0.5** | **0.33** | **0.33** | **0.0** | **0.5** | **0.0** | **0.0** | **0.5** |

## 10. Mapping to PSO

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | - | - | - | - |
| **CO2** | - | - | - | - |
| **CO3** | - | - | - | - |
| **CO4** | - | - | - | - |
| **CO5** | - | - | - | - |
| **CO6** | - | - | - | - |

***** End of Syllabus*****

**Course Name**: Compiler Design
**Course Code:** CS503
**(Semester-V)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

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1. **Course Prerequisite:**
   Knowledge of Formal Language & Automata Theory.
2. **Course Learning Objectives:**
   i. To understand and list the different stages in the compilation process.
   ii. Identify different methods of lexical analysis
   iii. Design top-down and bottom-up parsers
   iv. Identify synthesized and inherited attributes
   v. Develop syntax-directed translation schemes
   vi. Develop algorithms to generate code for a target machine
3. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –** Lectures and Presentations, Interactive Discussions, and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   **Course Name:** Compiler Design
   **Course Code:** CS503
   **Hours per Week:** 3L: 0T: 0P
   **Credits:** 3

| Module | Topics | Lectures |
|---|---|---|
| 1 | **Introduction to Compiling [3L]**<br>Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler. | 3L |
| 2 | **Lexical Analysis [6L]**<br>The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex). | 6L |
| 3 | **Syntax Analysis [9L]**<br>The role of a parser, Context- free grammar, Writing grammar, Top-down Parsing, Non-recursive Predictive parsing (LL), Bottom-up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques. | 9L |
| 4 | **Syntax-directed translation [5L]**<br>Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Bottom-up evaluation of inherited attributes | 5L |
| 5 | **Type checking [4L]** | 4L |

| | | |
|---|---|---|
| | Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions | |
| 6 | **Run time environments [5L]**<br>Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques. | 5L |
| 7 | **Intermediate code generation [4L]**<br>Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples). | 4L |
| 8 | **Code optimization [5L]**<br>Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in the flow graph, Peephole optimization. | 5L |
| 9 | **Code generations [4L]**<br>Issues in the design of code generator, a simple code generator, Register allocation & assignment. | 4L |

**6. References:**

**Text & References Books:**

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2. Holub - "Compiler Design in C" - PHI.

**7. Course Outcomes:**

**After going through this course, the students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **1** | **Explain** the phases of a compiler and their interdependencies. | **Explain** | Understand– Level 2 |
| **2** | **Apply** lexical and syntax analysis techniques to recognize tokens and parse grammar. | **Apply** | Apply – Level 3 |
| **3** | **Analyze** syntax-directed translation schemes and type-checking mechanisms. | **Analyze** | Analyze – Level 4 |
| **4** | **Evaluate** storage organization, runtime environments, and memory allocation strategies. | **Evaluate** | Evaluate – Level 5 |
| **5** | **Design** intermediate code representations and code optimization techniques. | **Design** | Create – Level 6 |
| **6** | **Implement** basic code generation strategies, including register allocation and instruction selection. | **Implement** | Create – Level 6 |

**8. Mapping of course outcomes to module/course content**

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | ✔ | - | - | - | - | - |
| 2 | - | ✔ | - | - | - | - |
| 3 | - | ✔ | - | - | - | - |
| 4 | - | - | ✔ | - | - | - |
| 5 | - | - | ✔ | ✔ | - | - |
| 6 | - | - | - | ✔ | - | - |
| 7 | - | - | - | - | ✔ | - |
| 8 | - | - | - | - | ✔ | ✔ |
| 9 | - | - | - | - | - | ✔ |

**9. Mapping of the Course Outcomes to Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |
| **CO2** | 2 | 3 | 3 | 2 | - | - | - | - | - | - | - | - |
| **CO3** | 2 | 2 | 3 | 3 | 2 | - | - | - | - | - | - | - |
| **CO4** | 3 | 2 | 2 | 3 | 3 | 2 | - | - | - | - | - | - |
| **CO5** | 2 | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - |
| **CO6** | 2 | 3 | 2 | 2 | 2 | 3 | - | - | - | - | - | - |
| **AVG.** | **2.33** | **2.5** | **2.33** | **2.16** | **1.66** | **1.33** | **-** | **-** | **-** | **-** | **-** | **-** |

**10. Mapping to PSO**

| | PSO1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - |
| **CO2** | 3 | 3 | 2 | - |
| **CO3** | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 2 | 2 | 3 |
| **CO5** | 2 | 3 | 3 | 3 |
| **CO6** | 2 | 2 | 3 | 3 |

***** End of Syllabus*****

**Course Name: Artificial Intelligence**
**Course Code: CS504**
**(Semester-V)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

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1. **Course Prerequisite:**
   **Mathematics:** Knowledge of probability distributions. Familiarity with logic, sets, relations, and functions.
   **Computer Science:** Understanding of search algorithms (e.g., BFS, DFS). Basic knowledge of time and space complexity analysis.

2. **Course Learning Objectives:**
   - Understand the fundamentals of AI.
   - Apply search techniques for problem-solving.
   - Develop knowledge representation and reasoning models.
   - Explore AI applications in Natural Language Processing.
   - Design and Develop Expert Systems
3. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –** Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   **Course Name: Artificial Intelligence**
   **Course Code: CS504**
   **Hours per Week:** 3L: 0T: 0P
   **Credits:** 3L

| Module | Topics | Lectures |
|---|---|---|
| 1 | Introduction [2]: Overview, history, and applications of AI, AI technique - Search, knowledge representation, learning, reasoning, Tic - Tac - Toe problem.<br>Intelligent Agents [2]: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.<br>State Space Search and Problem Characteristics [2]: Representation of state spaces using nodes and edges. Analyze problem(8-puzzle and route finding) characteristics. Issues (completeness, optimality, time complexity, and space complexity) in search program design. | 6 |

| | | |
|---|---|---|
| 2 | Search techniques [5] Solving problems by searching :problem solving agents, searching for solutions; uniform search strategies: breadth first search (Algorithm, implementation, and complexity analysis. Completeness and optimality), depth first search (Algorithm, implementation and complexity analysis. Advantages and limitations), depth limited search (implementation and handling infinite paths), bidirectional search, comparing uniform search strategies (Trade-offs between time complexity, space complexity, completeness, and optimality).<br>Heuristic search strategies [5]: Greedy best-first search, A* search, memory bounded heuristic search (Memory efficiency and trade-offs): local search algorithms & optimization problems: Hill climbing search (Variants: Stochastic Hill Climbing, Random-Restart Hill Climbing), simulated annealing search (probabilistic acceptance), local beam search, genetic algorithms (Basic concepts: Population, fitness function, crossover, mutation); constraint satisfaction problems, local search for constraint satisfaction problems.<br>Adversarial search [3] Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements (Iterative Deepening: Combining with Minimax for better performance), iterative deepening. | 13 |
| 3 | Knowledge & reasoning [3] Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation. | 3 |
| 4 | Using predicate logic [2] Representing simple facts in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Probabilistic reasoning [4] Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster -Shafer theory, Fuzzy sets & fuzzy logics. | 6 |
| 5 | Natural Language processing [2] Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing. Learning [2] Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevant information, neural net learning & genetic learning. Expert Systems [2] Representing and using domain knowledge, expert system shells, knowledge acquisition. | 6 |

## 6. References:

### Text & References Books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS 7. M.C. Trivedi, Artificial Intelligence, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

## 7. Course Outcomes:

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **CO1** | **Understand the fundamentals of AI and analyze intelligent agents and their interactions with environments.** | Understand Analyze | L2, L4 |
| **CO2** | **Apply search strategies for problem solving** | Apply, Evaluate | L3, L5 |
| **CO3** | **Utilize knowledge representation and reasoning techniques** | Apply | L3 |
| **CO4** | **Develop models by implementing learning algorithms** | Implement, Develop | L6 |
| **CO5** | **Understand Natural Language Processing and expert systems** | Understand | L2 |
| **CO6:** | **Evaluate AI applications and ethical considerations** | Evaluate | L5 |

## 8. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | 3 | 2 | 1 | - | - | 1 |
| 2 | - | 3 | 2 | - | - | 1 |
| 3 | - | - | 3 | 2 | - | - |
| 4 | - | - | 2 | 3 | - | 2 |
| 5 | - | - | - | 2 | 3 | 2 |
| | | | | | | |
| | | | | | | |

## 9. Mapping of the Course outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | 1 |
| **CO2** | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 3 | - | 2 | - | - | - | - | - | - | - |
| **CO4** | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | - | 2 |
| **CO5** | - | 2 | - | 3 | - | - | - | - | - | - | - | 2 |
| **CO6** | - | - | - | - | - | 2 | 2 | 3 | 3 | - | - | 3 |
| **AVG.** | **1.33** | **1.5** | **1.5** | **0.66** | **1.33** | **1.0** | **0.66** | **0.5** | **0.5** | **0.0** | **0.0** | **1.33** |

**10. Mapping to PSO**

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | 3 | - | 2 | 1 |
| **CO2** | 3 | 2 | - | - |
| **CO3** | 3 | 2 | - | - |
| **CO4** | 2 | 3 | 2 | - |
| **CO5** | - | 3 | 2 | 1 |
| **CO6** | - | 2 | 3 | 3 |

***** End of Syllabus*****

**Course Name: Data Mining**
**Course Code: CS505**
**(Semester-V)**
**Category: Major**
**Course Broad Category: Professional Elective Course**
**[For Computer Science and Engineering]**

……

1. **Course Prerequisite:**
   i. Data Structure and Algorithms
   ii. Database Management Systems
2. **Course Learning Objectives:**
   i. Be able to understand the principles and architectures of data warehousing and data mining.
   ii. Be able to analyze and design various pattern extraction techniques on the association, classification, and clustering of data.
   iii. Be able to understand the mining of text data, time series data and stream data.
   iv. Be able to understand graph mining and web mining.
   v. Be able to apply data mining techniques for solving real-life problems in various domains.
3. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –** Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   **Course Name:** Data Mining
   **Course Code:** CS505
   **Hours per Week:** 3L: 0T: 0P
   **Credits:** 3L

| Module | Topics | Lectures |
|---|---|---|
| 1 | Introduction: Data Mining Concept, Origin, Process, Applications, Techniques, Challenges, Introduction to Data Warehousing, Supervised and Unsupervised Learning. | 5 |
| 2 | Data Preprocessing: Data types, Quality, Descriptive data summarization – central tendency and dispersion measure, Data cleaning, Data integration & transform, Data reduction, Min-Max Scaling and Z-Score Normalization. | 4 |
| 3 | Association Rule Mining: Market-basket analysis basics, Apriori algorithm, Frequent Pattern Tree, Direct Hashing and Pruning (DHP).<br>Distance Metrics: Examples and four axioms. | 5 |
| 4 | Classification: k-Nearest Neighbors, Naïve Bayes, Decision Tree, Random Forests, Support Vector Machines, Rule-based classification.<br>Prediction: Linear Regression, Logistic Regression. | 9 |
| 5 | Cluster Analysis: Types of data in cluster analysis, Partitioning methods- k-Means, k-Medoids, PAM, CLARA, CLARANS; Hierarchical methods- Agglomerative clustering; Density-based methods- DBSCAN; Grid-based methods- STING. | 7 |
| 6 | Introduction to: Text Mining: Hidden pattern mining in text; Mining Time Series Data: Periodicity and trend analysis for time series data; Mining Data Streams: Pattern mining in stream data; and Graph Mining: Social Network Analysis. | 6 |
| 7 | Web Data Mining: Web content mining, Web usage mining, Web structure mining, Hubs and Authorities, HITS, PageRank, Data Mining Applications & Information Privacy Security and Social Impacts. | 4 |

## 6. References:

**Text & References Books:**


i. Data Mining Techniques, by Arun K Pujari.

ii. Data Mining Concepts and Techniques, by Jiawei Han and M Kamber.

iii. Introduction to Data Mining, by Pang-Ning Tan and Vipin Kumar.


## 7. Course Outcomes:

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| CS505.CO1 | Understand the principles and architectures of data warehousing and data mining. | Understand | K2 |
| CS505.CO2 | Analyze and design various pattern extraction techniques on the association, classification, and clustering of data. | Analyze and design | K4 |
| CS505.CO3 | Understand the mining of text data, time series data and stream data. | Understand | K2 |
| CS505.CO4 | Understand graph mining and web mining. | Understand | K2 |
| CS505.CO5 | Apply data mining techniques for solving real-life problems in various domains. | Apply | K3 |

## 8. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| 1 | 3 | - | - | - | - |
| 2 | - | 3 | - | - | - |
| 3 | - | 3 | - | - | - |
| 4 | - | 3 | - | - | - |
| 5 | - | 3 | - | - | - |
| 6 | - | - | 3 | 3 | - |
| 7 | - | - | - | 3 | 3 |

## 9. Mapping of the Course Outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO2** | - | 3 | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | 2 | 2 | - | - | - | - | - | - | 3 |
| **CO5** | 2 | - | - | - | - | - | - | - | - | - | - | 3 |
| **AVG.** | **2.0** | **3.0** | **3.0** | **2.0** | **2.0** | **0** | **0** | **0** | **0** | **0** | **0** | **3.0** |

**10. Mapping to PSO**

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 2 |
| **CO3** | 3 | 3 | 2 | 2 |
| **CO4** | 3 | 3 | 2 | 2 |
| **CO5** | 3 | 3 | 2 | 2 |

***** End of Syllabus*****

**Course Name: Computer Graphics**
**Course Code: CS506**
**(Semester – I)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

……

1. **Course Prerequisite:**
   ...

2. **Course Learning Objectives:**
   i. …
3. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –**Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   **Course Name: Computer Graphics**
   **Course Code: CS506**
   **Hours per Week:** 3L:0T:0P
   **Credits:** 3

| Module | Topics | Lectures |
|---|---|---|
| **Unit 1: Introduction to computer graphics & graphics systems** | Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software. **Scan conversion [8L]:** Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm. | 6L |
| **Unit 2:2D transformation & viewing** | Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method 3D transformation & viewing [5L]: 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing | 15L |

| | | |
|---|---|---|
| **Unit 3: Curves** | Curve representation, surfaces, designs, Bezier curves,B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.<br>**Hidden surfaces [3L]:** Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal - geometry. **Color & shading models [2L]:** Light & color model; interpolative shading model; Texture.<br>**Introduction to Ray-tracing:** [3L] Human vision and color, Lighting, Reflection and transmission models. | 6L |

## 6. References:

### Text & References Books:


1. Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson educationZ. Xiang, R. 2. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH

3. D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH


### Course Outcomes:

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## 7. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - |
| 2 | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - |

## 8. Mapping of the Course outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | - | - | - | - |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO6** | - | - | - | - | - | - | - | - | - | - | - | - |
| **AVG.** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |

## 9. Mapping to PSO

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | - | - | - | - |
| **CO2** | - | - | - | - |
| **CO3** | - | - | - | - |
| **CO4** | - | - | - | - |
| **CO5** | - | - | - | - |
| **CO6** | - | - | - | - |

***** End of Syllabus*****

**Course Name: Advanced Computer Architecture**
**Course Code: CS-507**
**(Semester- V)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

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1. **Course Prerequisite:**
   i. Fundamentals of Computer Organization & Architecture
   ii. Basic knowledge of Digital Logic Design
   iii. Concepts of Parallel Processing and Memory Systems
2. **Course Learning Objectives:**
   i. Understand the evolution of computer architectures and modern performance metrics.
   ii. Explore the principles of instruction-level parallelism and pipelining.
   iii. Analyze memory hierarchy, cache coherence, and multiprocessor interconnects.
   iv. Understand parallel computing models and reconfigurable architectures.
   v. Study modern processor architectures, including RISC, CISC, VLIW, and GPUs.

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3. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –**Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   **Course Name: Advanced Computer Architecture**
   **Course Code: CS-507**
   **Hours per Week:** 3L:0T:0P
   **Credits:** 3

| Module | Topics | Lectures |
|---|---|---|
| Unit 1 | Evolution of computer systems: Von Neumann & Harvard architectures, IBM 360/370, DEC PDP-11[1L]Flynn's Taxonomy: SISD, SIMD, MISD, MIMD[1L],Performance Metrics: CPI, MIPS, FLOPS, SPEC benchmarks,[2L],Amdahl's Law and Gustafson's Law in parallel processing.[2L] | 6L |
| Unit 2 | Concepts of instruction pipelining, pipeline hazards: structural, data, and control hazards, Techniques for hazard resolution: forwarding, branch prediction, delay slots[3L], Superscalar and VLIW architectures,Out-of-order execution, speculative execution, and branch prediction[5L] | 8L |
| Unit 3 | Memory hierarchy: Registers, cache, main memory, secondary storage [2L],Cache memory: Direct-mapped, associative, and set-associative caches,Virtual memory: Page tables, TLB, demand paging,[3L],Cache coherence and memory consistency models,Multiprocessor interconnects: Shared memory vs. distributed memory architectures[5L] | 10L |
| Unit 4 | Shared memory multiprocessors and synchronization mechanisms[2L],Multicore architectures: Homogeneous vs. heterogeneous cores[2L] , GPU architectures: CUDA, OpenCL basics, Performance scalability and parallel computing models (PRAM, VLSI models), Power-efficient computing and green architectures.[6L] | 10L |
| Unit 5 | Basics of FPGA and reconfigurable computing, Hardware Description Languages (HDL) for reconfigurable computing,[3L],Quantum computing basics and neuromorphic computing, Cloud computing and server architectures,Trends in high-performance computing (HPC) and data center architectures.[5L] | 8L |

## 6. References:


1. Hwang, K., Jotwani, N., Advanced Computer Architecture, Tata McGraw Hill.

2.Patterson, D.A., Hennessy, J.L., Computer Organization & Design, Morgan Kaufmann.

3.Flynn, M.J., Computer Architecture: Pipelined and Parallel Processor Design, Narosa.

4. Stallings, W., Computer Organization & Architecture: Designing for Performance, PHI.

5. Tanenbaum, A.S., Structured Computer Organization, PHI.

6. Noergaard, T., Embedded Systems Architecture: A Comprehensive Guide, Elsevier.

## 7. Course Outcomes:

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| CS-507.CO1 | Explain the evolution of computer architecture and performance analysis | Explain | K2 |
| CS-507.CO2 | Analyze instruction pipelining and hazard resolution techniques | Analyze | K2 |
| CS-507.CO3 | Compare memory hierarchy and evaluate cache coherence techniques | Compare | K1 |
| CS-507.CO4 | Design efficient parallel computing and multicore architectures | Design | K4 |
| CS-507.CO5 | Develop FPGA-based reconfigurable architectures | Develop | K4 |
| CS-507.CO6 | Explore emerging trends like quantum and cloud computing | Explore | K1 |

## 8. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | Y | Y | Y | - | - | - |
| 2 | - | Y | Y | - | - | - |
| 3 | - | - | - | Y | - | - |
| 4 | - | - | - | - | Y | Y |
| 5 | Y | | Y | Y | | Y |

## 9. Mapping of the Course outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | - | - |
| **CO2** | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | - |
| **CO3** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | - |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | - |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | 3 |
| **AVG.** | **3** | **2.67** | **3** | **2.5** | **2.6** | **1.3** | **0.0** | **0.0** | **2.3** | **1.3** | **1.8** | **2.5** |

## 10. Mapping to PSO

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | 3 | 3 | | 1 |
| **CO2** | 3 | 3 | | 1 |
| **CO3** | 3 | 3 | | 1 |
| **CO4** | 3 | 3 | | 1 |
| **CO5** | 3 | 3 | | 1 |
| **CO6** | 3 | 3 | | 1 |

***** End of Syllabus*****

**Course Name: Distributed Database Management System**

**Course Code: CS508**

**Category: Major**

**Course Broad Category: Engineering Science Course**

**[For Computer Science and Engineering]**

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5. **Course Prerequisite:**
   Database Management Systems
6. **Course Learning Objectives:**
   ii. To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problemsTo equip students with knowledge and practical skills essential for understanding modern computing systems and networks.
7. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –**Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   D. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   E. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   F. End-Semester Exam (60 Marks)- Summative Assessment.
8. **Course Content:**
   **Course Name: Distributed Database Management System**
   **Course Code: CS508**
   **Hours per Week:** 3L:0T:0P
   **Credits:** 3

| Module | Topics | Lectures |
|---|---|---|
| **Unit 1: INTRODUCTION** | Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts **DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE** Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues | 8L |
| **Unit 2: DISTRIBUTED DATABASE DESIGN** | Alternative design strategies; Distributed design issues; Fragmentation; Data allocation **SEMANTICS DATA CONTROL** View management; Data security; Semantic Integrity Control **QUERY PROCESSING ISSUES** Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data | 11L |
| **Unit 3: DISTRIBUTED QUERY OPTIMIZATION** | Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms **TRANSACTION MANAGEMENT** The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models **CONCURRENCY CONTROL** Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management | 11L |
| **Unit 4:** | Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols Algorithm | 8L |

| | | |
|---|---|---|
| | (OS): Role and Types (CLI-based OS, GUI-based OS), Mobile OS and Network OS. | |
| **Unit5:PARALLEL DATABASE** | **PARALLEL DATABASE SYSTEMS** Parallel architectures; parallel query processing | 6L |
| **Unit 6: ADVANCED TOPICS Mobile** | **ADVANCED TOPICS Mobile** Databases, Distributed Object Management, Multi-databases | 4L |

**10. References:**

**Text & References Books:**


1. Principles of Distributed Database Systems, M.T. Ozsu and PValduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, AddisonWesley, 1992.


**11. Course Outcomes:**

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| | Design trends in distributed systems. | | |
| | Apply network virtualization. | | |
| | Apply remote method invocation and objects. | | |
| | | | |
| | | | |
| | | | |

**12. Mapping of course outcomes to module / course content**

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - |
| 2 | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - |

**13. Mapping of the Course outcomes to Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | - | - | - | - |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO6** | - | - | - | - | - | - | - | - | - | - | - | - |
| **AVG.** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |

## 14. Mapping to PSO

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | - | - | - | - |
| **CO2** | - | - | - | - |
| **CO3** | - | - | - | - |
| **CO4** | - | - | - | - |
| **CO5** | - | - | - | - |
| **CO6** | - | - | - | - |

***** End of Syllabus*****

**Course Name: Linear Algebra&Numerical Methods**
**Course Code: CS515**
**(Semester V)**
**Course Broad Category: B. Tech CSE**

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9. **Course Prerequisite:**
   Concept of Mathematics in the previous semesters of B. Tech curriculum.

10. **Course Learning Objectives:**
    This course is designed to provide students with an understanding of Mathematical concept on Linear algebra that includes basic as well as advanced level. Attempt is taken to cover both theoretical as well as computation perspectives. These includes the following components: (i)Vector spaces, (ii) Linear transformations, (iii) Inner product spaces and different operators in it. This module also attempts to develop the concept of Numerical methods in (i) solution of system of linear equations, (ii) introduction of Gauss quadrature in solution of ODE (iii) Mesh techniques in solving one dimensional heat and wave equation and (iv) introduction of spline interpolation and iterative methods for finding the eigen values and eigen vectors.

11. **Teaching methodology and evaluation system for the course:**
    **Teaching methodology –** Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

    **Evaluation System –**

G. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
H. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
I. End-Semester Exam (60 Marks)- Summative Assessment.

12. **Course Content:**
    **Course Name: Linear Algebraand Numerical Methods**
    **Course Code: CS515**
    **Hours per Week:** 3L: 1T: 0P
    **Credits:** 3

| Module | Topics | 45L |
|---|---|---|
| 1. | **Vector space over a field** - Definition and examples, Definition of subspace and intersection, union and sum of two subspaces, Definition of linear span, linearly dependent set, basis and dimensions of a vector space and examples related to it, Extension theorem, ordered basis and coordinate matrix with respect to the ordered basis, Change of Ordered basis in finite dimensional vector space (to find the coordinate matrix by changing the ordered basis), Row space of a matrix, computations concerning subspaces. | 9L |
| 2. | **Linear Transformation-**Definition, examples, properties, range space and null space of a linear transformation, rank nullity theorem, concept of row rank and column rank, Algebra of linear transformations, theorem related to the dimension of L (V, W), definition of linear operator and linear algebra, concept of inverse | 14L |

| Module | Topics | 45L |
|---|---|---|
| | linear transformation and isomorphism, matrix representation of linear transformations – some examples and related theorems.<br>Inner products, norms, orthonormal bases, spectral theorem, unitary and orthogonal transformations. | |
| 3. | **Numerical solution of a system of linear equations:**<br>Direct and indirect/iterative method, Gauss elimination method, Matrix inversion, LU Factorization method, diagonally dominant of a matrix, Gauss-Seidel iterative method. | 6L |
| 4. | **Numerical solution of ordinary differential equation:** Gaussian Quadrature.<br>**Numerical solution of partial differential equation:** Finite Difference Methods for: Elliptic equations (Laplace Equation), Parabolic equations (Heat Equation), Hyperbolic equations (Wave Equation). | 8L |
| 5. | **Interpolation and Curve Fitting:** Spline Interpolation, Least Squares Method for Curve Fitting.<br>**Eigenvalues and eigenvectors**: Introduction to iterative methods for finding the largest and smallest eigenvalues and corresponding eigenvectors respectively (Power and Inverse Power Methods). | 8L |

**5.**

**References:**

**Text Book:**


- Raisinghania, M.D.: Linear Algebra, S. Chand Publishing.
- Balakrishnan, V.K.: Linear Algebra, Schaum's Outline Series.
- Strang, G.: Introduction to Linear Algebra (Fifth Edition), Wellesley-Cambridge Press.
- Hoffman, K., and Kunze, R.: Linear Algebra, Prentice Hall.
- S.C. Chapra and R.P. Canale, *Numerical Methods for Engineers*, McGraw Hill Education.
- M.K. Jain, S.R.K. Iyengar, and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, New Age International Publishers.
- S.S. Sastry, *Introductory Methods of Numerical Analysis*, PHI Learning Pvt. Ltd.


**Reference Books:**


- Friedberg, Stephen H., Insel, Arnold J., and Spence, Lawrence E.: Linear Algebra, Pearson.
- Axler, Sheldon: Linear Algebra Done Right (2nd Edition), Springer.
- Dummit, D.S., and Foote, R.M.: Abstract Algebra, Wiley.
- Lay, David C., Lay, Steven R., and McDonald, Judi J.: Linear Algebra and Its Applications, Pearson.
- Dass, H.K., and Verma, Rama: Linear Algebra, S. Chand Publishing.
- Prasad, K.C., and Datta, K.B.: Linear Algebra, Narosa Publishing House.
- Curtis F. Gerald and Patrick O. Wheatley, *Applied Numerical Analysis*, Pearson Education.
- Steven C. Chapra, *Applied Numerical Methods with MATLAB*, McGraw Hill Education.
- Richard L. Burden and J. Douglas Faires, *Numerical Analysis*, Cengage Learning.
- P. Kandasamy, K. Thilagavathy, and K. Gunavathi, *Numerical Methods*, S. Chand Publishing.
- N. Datta, *Numerical Linear Algebra and Applications*, PHI Learning Pvt. Ltd.


## 6. CourseOutcomes (CO):

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **CS515.1** | Ability to understand the basic concepts of vector and matrix algebra, including | Identify | Remember |

| | | | |
|---|---|---|---|
| | linear dependence / independence, basis and dimension of a subspace, for analysis of matrices and systems of linear equations | | |
| **CS515.2** | Ability to find the dimension of spaces such as those associated with matrices and linear transformations. | Explain | Understand |
| **CS515.3** | Apply the concept of numerical techniques to solve system of linear equations. | Implement | Apply |
| **CS515.4** | Learn to apply the concept of Gaussian quadrature in solving ODE and mesh techniques in solving one dimensional heat and wave equations. | Organize | Analyze |
| **CS515.5** | Understanding to Apply the techniques of spline interpolation and also to apply the algorithms to find the largest/ smallest eigen values and corresponding eigen vectors. | Assess | Evaluate |
| **CS515.6** | Build up logical and analytical skills to create a new idea appreciated by academics, research & emerging trends in industry. | Construct | Create |

**7. Mapping of course outcomes to module / course content**

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | 3 | 2 | - | - | - | 1 |
| 2 | 3 | 3 | - | - | - | 1 |
| 3 | 2 | 1 | 3 | 2 | 2 | 1 |
| 4 | 2 | 1 | 3 | 3 | 1 | 1 |
| 5 | 2 | 1 | 2 | 2 | 3 | 1 |

**8. Mapping of the Course outcomes to Program Outcomes**

| | PO1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 1 | 2 | - | - | - | - | - | - | 1 |
| **CO2** | 1 | 2 | 3 | 1 | - | - | - | - | - | - | - | 1 |
| **CO3** | 1 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | 1 |
| **CO4** | 1 | 2 | 1 | 1 | 2 | - | - | - | - | - | - | 2 |
| **CO5** | 2 | 2 | 2 | 2 | 3 | - | - | - | - | - | - | 1 |
| **CO6** | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | 1 |

## 9. Mapping to Program Specific Outcome (PSO)

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | | | | |
| CO2 | | | | |
| CO3 | | | | |
| CO4 | | | | |
| CO5 | | | | |
| CO6 | | | | |

**Course Name: Open Elective I: Multimedia System**

**Course Code: CS517**

**Category: Major**

**Course Broad Category: Engineering Science Course**

**[For Computer Science and Engineering]**

……

**13. Course Prerequisite:**

…

**14. Course Learning Objectives:**

**15. …**

**16. Teaching methodology and evaluation system for the course:**

**Teaching methodology –**Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

J. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)

K. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]

L. End-Semester Exam (60 Marks)- Summative Assessment.

**17. Course Content:**

**Course Name: Multimedia System**

**Course Code: CS517**

**Hours per Week:** 3L:0T:0P

**Credits:** 3

| Module | Topics | Lectures |
|---|---|---|
| **Unit 1:** | Introduction: Multimedia today, Impact of Multimedia, Multimedia Systems, Components and ItsApplications | 2L |
| **Unit 2:** | Text and Audio, Image and Video(14L) Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption; Audio: Basic Sound Concepts, Typesof Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI Image: Formats, Image Color Scheme, ImageEnhancement; Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture, and Computer based Animation. | 14L |
| **Unit 3:** | Synchronization, Storage models and Access Techniques:Temporal relationships, synchronizationaccuracy specification factors, quality of service, Magnetic media, optical media, file systems(traditional, multimedia) Multimedia devices – Output devices, CD-ROM, DVD, Scanner, CCD | 8L |
| **Unit 4:** | Image and Video Database, Document Architecture and Content Management (17L): Imagerepresentation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- kd trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, videosegmentation, indexing, Content Design and Development, General Design Principles Hypertext: Concept, Open Document Architecture (ODA), Multimedia and Hypermedia Coding Expert Group(MHEG), Standard Generalized Markup Language (SGML), Document Type | 17L |

| | | |
|---|---|---|
| | Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing. Case study of Applications | |
| **Unit 5:** | Multimedia Applications(4L): Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, mediaeditors | 4L |

**15. References:**

**Text & References Books:**

**16. Course Outcomes:**

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **CS517.CO1** | Learn technical aspect of Multimedia Systems | Learn | K1 |
| **CS517.CO2** | Understand the standards available for different audio,video Image and text applications | Understand | K2 |
| **CS517.CO3** | Design various available storage model for multimedia and can give a comparison study between them. | Design | K3 |
| **CS517.CO4** | Compare between different available multimedia document architecture. | Compare | K4 |
| **CS517.CO5** | Explain technical aspects of popular multimedia web applications, including VoD and VoIP | Explain | K5 |
| **CS517.CO6** | Develop multimedia application and analyze the performance of the same | Develop | K6 |

**17. Mapping of course outcomes to module / course content**

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - |
| 2 | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - |

**18. Mapping of the Course outcomes to Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO6** | - | - | - | - | - | - | - | - | - | - | - | - |
| **AVG.** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |

**19. Mapping to PSO**

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | - | - | - | - |
| **CO2** | - | - | - | - |
| **CO3** | - | - | - | - |
| **CO4** | - | - | - | - |
| **CO5** | - | - | - | - |
| **CO6** | - | - | - | - |

***** End of Syllabus*****

**Course Name: Augmented Reality, Virtual Reality**
**Course Code: CS518**
**(Semester – I)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

……

**Course Prerequisite:**

Learn and understand the fundamental concepts of AR/VR/MR.
Apply the learned concepts to design moderate to large AR/VR based systems.
Understand rendering in AR/VR/MR and challenges
Be able to use geometric modeling algorithms to design virtual worlds
Be able to design user interactions in AR/VR

**Course Learning Objectives:**

1. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –** Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
2. **Course Content:**
   **Course Name: Augmented Reality, Virtual Reality**
   **Course Code: CS518**
   **Hours per Week:** 3L: 0T: 0P
   **Credits:** 3

| Module | Topics | Lectures |
|---|---|---|
| **Unit 1:** | Introduction, Historical perspective, Graphics pipeline, Real-time rendering in VR, Transformations,viewing and projection, Geometric modelling | 12L |
| **Unit 2:** | Light and optics, lens systems and imaging, lens aberrations, Stereoscopy, depth and motionperception, Human perception: visual, audio, vestibular, and tactile | 12L |
| **Unit 3:** | Introduction to Augmented Reality (AR), Mixed Reality (MR), Extended Reality (xR); Taxonomy,technology and features of augmented reality, difference between AR, VR, MR; Challenges withAR, AR systems and functionality, Augmented reality methods, visualization techniques foraugmented reality, wireless displays in educational augmented reality applications, mobile projectioninterfaces, marker-less tracking for augmented reality, enhancing interactivity in AR/MRenvironments, evaluating AR systems. | 10L |
| **Unit 4: Types** | Procedural modelling and creation of large virtual worlds, Telepresence and interaction, Userinterfaces, social interaction and evaluation of VR systems. | 10L |

**References:**

**Text & References Books:**

1. Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience,India, 2003.

2. LaValle "Virtual Reality", Cambridge University Press, 2016, edition, 2009.

3. Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, and Ivan Poupyrev, 3D User Interfaces,Addison-Wesley, 2005.

4. K. S. Hale and K. M. Stanney, Handbook on Virtual Environments, 2nd edition, CRC Press,2015.

5. Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005

. 6. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D UserInterfaces, Theory and Practice”, Addison Wesley, USA, 2005.

7. Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Meging Real and VirtualWorlds”, 2005.

## 6. Course Outcomes:

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **1.** | Comprehensive understanding of the graphics pipeline, from geometric modeling to real-time rendering techniques used in virtual reality and gain the practical knowledge of transformations, viewing, and projection, and how these concepts are applied to produce high-quality visual experiences in interactive environments. | Understand | L2 |
| **2.** | Understanding of light and optics, lens systems, and imaging, along with the effects of lens aberrations and stereoscopy on visual perception and explore how depth, motion, and human sensory systems—including visual, audio, vestibular, and tactile—contribute to immersive experiences in virtual and augmented reality environments. | Apply | L3 |
| **3.** | Understanding the fundamentals of Augmented Reality (AR), Mixed Reality (MR), and Extended Reality (xR), including their taxonomy, technologies, features, and the differences between AR, VR, and MR and gain the practical knowledge in AR system functionality, visualization techniques, mobile projection interfaces, marker-less tracking, and methods for enhancing interactivity in AR/MR environments, while learning how to evaluate and address challenges in designing AR systems. | Identify | L1 |
| **4.** | Acquired the knowledge to create large virtual worlds through procedural modeling, understand telepresence and interaction techniques, design effective user interfaces, and evaluate social interaction and VR systems. | Analyze | L4 |
| | | | |
| | | | |

## 7. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | 3 | - | - | - | - | - |
| 2 | - | 3 | 3 | - | - | - |
| 3 | - | - | 3 | - | - | - |
| 4 | - | - | - | 3 | - | - |
| 5 | - | - | - | - | 3 | - |
| 6 | - | - | **1.0** | **1.33** | - | 3 |
| 7 | - | - | - | - | - | 3 |

## 8. Mapping of the Course outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 3 | - | 2 | - | - | - | - | - | - | - | - |
| **CO3** | 3 | | 2 | - | - | - | - | - | - | - | - | - |
| **CO4** | | - | - | - | - | 2 | 2 | - | - | - | - | - |
| **CO5** | - | 3 | - | - | 3 | - | - | - | - | - | - | - |
| **CO6** | - | - | - | - | - | - | - | - | - | 3 | - | 3 |
| **AVG.** | **1.0** | **1.33** | .33 | **.33** | .5 | **.33** | .33 | **0.0** | **0.5** | **0.0** | **0.0** | **0.5** |

## 9. Mapping to PSO

| | PSO1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| **CO1** | - | - | - | - |
| **CO2** | - | - | - | - |
| **CO3** | - | - | - | - |
| **CO4** | - | - | - | - |
| **CO5** | - | - | - | - |
| **CO6** | - | - | - | - |

***** End of Syllabus*****

**Course Name:** Operating System Lab
**Course Code:** CS591
**(Semester-V)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

……

1. **Course Prerequisite:**
   Basic Programming.
2. **Course LEARNING Objectives:**
3. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –** Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   **Course Name:** Operating System Lab
   **Course Code:** CS591
   **Hours per Week:** 4L
   **Credits:** 2L

| Module | Topics | Lectures |
|---|---|---|
| 1 | Managing Unix/Linux Operating System [8P]: Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock, I-nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules and methods Kernel loading, init and the init tab file, Run-levels, Run level scripts. Password file management, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, switching user, switching group, Removing users &user groups. | 8 |
| 2 | Process [4P]: starting new process, replacing a process image, waiting for a process, zombie process. | 6 |
| 3 | Signal [4P]: signal handling, sending signals, signal interface, signal sets. | 8 |
| 4 | Semaphore [6P]: programming with semaphores | 8 |
| 5 | Threads [6P]: programming with pthread functions | 10 |
| 6 | Inter-process communication [6P]: pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO), message passing & shared memory(IPC version V). | 8 |

## 6. References:

**Text & References Books:**

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, WilliamStallings, Prentice Hall of India.

## 7. Course Outcomes:

**After going through this course,the students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **CO1** | Operates on UNIX / Linux operating systems with various shell commands, including different kernel-level activities. | Understand | L2 |
| **CO2** | Understanding of shell script. | Understand | L2 |
| **CO3** | Implement synchronization using semaphore and thread. | Implement | L3 |
| **CO4** | Implement different types of process and thread. | Understand | L2 |
| **CO5** | Implement the concept of pipes for improving the efficiency of an operating system in terms of speed up and throughput. | Implement | L3 |

## 8. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| 1 | 3 | - | - | - | - |
| 2 | 2 | - | - | - | - |
| 3 | - | - | 3 | - | - |
| 4 | - | - | 3 | - | - |
| 5 | - | - | - | 3 | - |
| 6 | - | - | - | - | 3 |

## 9. Mapping of the Course outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | 2 | | | | | | | |
| **CO2** | 2 | 3 | 3 | | | | | | | | | |
| **CO3** | 2 | 3 | 3 | | | | | | | | | |
| **CO4** | 2 | 3 | 3 | 2 | 2 | | | | | | | |
| **CO5** | 2 | 3 | 3 | 3 | | | | | | | | |
| **AVG.** | 2.25 | 2.75 | 3 | 2 | | | | | | | | |

## 10. Mapping to PSO

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 1 |
| **CO2** | 3 | 3 | 2 | 1 |
| **CO3** | 3 | 3 | 2 | 1 |

| | | | | |
|---|---|---|---|---|
| **CO4** | 3 | 3 | 2 | 1 |
| **CO5** | 3 | 3 | 2 | 1 |

***** End of Syllabus*****

**Course Name:** Software Engineering Lab
**Course Code:** CS-592
**(Semester-V)**
**Category: Major**
**Course Broad Category: Engineering Science Course**
**[For Computer Science and Engineering]**

……

1. **Course Prerequisite:**
   Problem Analysis and Project Planning –Thorough study of the problem.
2. **Course Learning Objectives:**
3. **Teaching methodology and evaluation system for the course:**
   **Teaching methodology –** Lectures and Presentations, Interactive Discussions and Case Studies.
   **Evaluation System –**
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   **Course Name:** Software Engineering Lab
   **Course Code:** CS-592
   **Hours per Week:** 3L: 0T: 0P
   **Credits:** 3L

| Module | Topics | Lectures |
|---|---|---|
| 1 | Problem Analysis and Project Planning -Thorough study of the problem – Identify Project Software Requirement Analysis – Describe the individual Phases/modules of the project.. | 8 |
| 2 | scope, Objectives and Infrastructure. Prototype model – Develop the prototype of the product | 4 |
| 3 | Software Designing - Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams | 4 |
| 4 | Data Modeling – Use work products – data dictionary | 4 |
| 5 | and Identify deliverables. Identify functional and non-functional requirements. The SRS and prototype model should be submitted for end semester examination. | 4 |

6. **References:**

**Text & References Books:**

7. **Course Outcomes:**

**After going through this course the Students will be able to:**

| Course Outcomes | Details/Statement | Action Verb | Knowledge Level |
|---|---|---|---|
| **1** | To understand the software engineering methodologies involved in the phases for project development. | Understand | L2 |
| **2** | To gain knowledge about open source tools used for implementing software engineering methods. | Identify | L1 |
| **3** | To exercise developing product-startups implementing software engineering methods. | Analyze | L4 |
| **4** | Learn simple optimization techniques | Understand | L2 |

## 8. Mapping of course outcomes to module / course content

| Module | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| 1 | 3 | - | - | - | - | - |
| 2 | - | 3 | - | - | - | - |
| 3 | - | - | 3 | - | - | - |
| 4 | - | - | - | 3 | - | - |
| 5 | - | - | - | - | 3 | - |
| 6 | - | 3 | - | - | - | - |
| 7 | - | - | - | - | - | 3 |

## 9. Mapping of the Course outcomes to Program Outcomes

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 3 | - | 2 | - | - | - | - | - | - | - | - |
| **CO3** | 3 | - | 2 | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | - | - | 2 | 2 | - | - | - | - | - |
| **CO5** | - | 3 | - | - | 3 | - | - | - | - | - | - | - |
| **CO6** | - | - | - | - | - | - | - | - | 3 | - | - | 3 |
| **AVG.** | **1.0** | **1.33** | **0.33** | **0.33** | **0.5** | **0.33** | **0.33** | **0.0** | **0.5** | **0.0** | **0.0** | **0.5** |

## 10. Mapping to PSO

| | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | - | - | - | - |
| CO2 | - | - | - | - |
| CO3 | - | - | - | - |
| CO4 | - | - | - | - |
| CO5 | - | - | - | - |
| CO6 | - | - | - | - |

***** End of Syllabus*****