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 System / 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]

1. **Course Prerequisite:**
   - Computer Architecture
   - Computer Organization

2. **Course Learning Objectives:**
   i. To learn the mechanisms of OS to handle processes and threads and their communication.
   ii. To learn the mechanisms involved in memory management.
   iii. To gain knowledge on process synchronization.
   iv. To learn about deadlock, memory management, and file management.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions, and Case Studies.
   Evaluation System –
   1. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   2. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   3. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content**
   Course Name: Operating Systems
   Course Code: CS501
   Hours per Week: 3L
   Credits: 3

Module	Topics	Lectures
Unit 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
Unit 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)	8
Unit 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.	8
Unit 4	Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	5
Unit 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

Unit 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
Unit 7	Evolution from traditional operating systems to modern OS, Introduction to Android OS and its architecture, Introduction to TinyOS for wireless sensor networks and resource-constrained devices, Overview of embedded operating-system concepts, Introduction to Contiki OS and its applications in IoT and low-power devices, Introduction to FreeRTOS and real-time operating-system concepts, Comparative overview of Android, TinyOS, Contiki OS, and FreeRTOS.	3

5. References:

Text & References Books:

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

6. Course Outcomes:

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

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS501.CO1	Understand the necessity, development, numerous classification, and design issues of the operating system.	Understand	L2
CS501.CO2	Apply different methods for implementing processes and threads as well as the various process scheduling algorithms.	Apply	L3
CS501.CO3	Identify different challenges associated with deadlock, concurrency, and different synchronization mechanisms	Identify	L1
CS501.CO4	Analyze several memory management strategies for memory allocations and implementation of virtual	Analyze	L4
CS501.CO5	Understand I/O management, disc management, file system structure, and different modern operating systems.	Understand	L2

7. 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

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS501.CO1	2	1	—
CS501.CO2	2	2	—
CS501.CO3	2	1	—
CS501.CO4	2	1	—
CS501.CO5	2	1	—

***** End of Syllabus*** < CS501>**

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:**
   Object Oriented Programming
   Database Management Systems

2. **Course Learning Objectives:**
   Identify and define the various phases of software development lifecycle
   Learn different design methods
   Learn coding style (structured or object oriented)
   Learn and apply software testing techniques

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
Unit 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, Function Point Analysis. Understanding of SRS documentation. [10L]	10
Unit 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
Unit 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 & Verification Metrics, Monitoring & Control. [8L]	12
Unit 4	Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring, Analysis of Critical Path Method (CPM), PERT, and Gantt Chart. [7L]	7
Unit 5	Static and dynamic models, why modeling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram. Case studies on software-based projects. [10L]	10

5. **References:**

   Text & References Books:

- Pressman, Software Engineering : A practitioner's approach– (TMH)
- Pankaj Jalote, Software Engineering- (Wiley-India)
- N.S. Gill, Software Engineering – (Khanna Publishing House)

- Rajib Mall, Software Engineering- (PHI)
- Agarwal and Agarwal, Software Engineering – (PHI)
- Sommerville, Software Engineering – Pearson
- Martin L. Shooman, Software Engineering – TMH

6. Course Outcomes:

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

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS502.CO1	Identify and define the various phases of lifecycle for a given project and the appropriate process model depending on the user requirements in order to develop a cost effective software product.	Identify	L2
CS502.CO2	Distinguish between a structure chart and a flow chart and Identify the activities carried out during transform.	Distinguish	L2
CS502.CO3	Choose between the coding style (Structured or Object Oriented) and Perform Code review, Code analysis, build process	Choose	L4
CS502.CO4	Judge appropriate software testing techniques to the quality of a software product at modules, integration, and system granularity levels.	Judge	L4
CS502.CO5	Apply the principles, processes and main knowledge areas for Software Project Management.	Apply	L3
CS502.CO6	Design different types of UML diagram with knowledge when and why use a particular type of dig based on the software product requirements	Design	L3

7. 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	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-
CO3	3	-	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2	-	-	-	-	-
CO5	-	3	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	3	-	-	3
AVG.	**3.0**	**2.7**		**2.0**	**3.0**	**2.0**	**0.0**	**3.0**	**0.0**	**0.0**	**3.0**

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS502.CO1	2	3	—
CS502.CO2	2	2	—
CS502.CO3	2	3	—
CS502.CO4	2	3	—
CS502.CO5	2	3	—
CS502.CO6	2	3	—

***** End of Syllabus*** < CS502>**

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

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]** Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.	3L
2	**Lexical Analysis [6L]** 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 [12L]** 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. Syntax-directed translation Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Bottom-up evaluation of inherited attributes	12L
4	**Type checking [9L]** Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions Run time environments 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.	9L

5	**Intermediate code generation [4L]** Intermediate languages, Graphical representation, Three-address code, Implementation of three-address statements (Quadruples, Triples, Indirect triples).	4L
6	**Code optimization and Code generation [8L]** 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. Issues in the design of code generator, a simple code generator, register allocation & assignment.	8L

5. References:

Text & References Books:

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

6. Course Outcomes:

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

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS503.CO1	Explain the phases of a compiler and their interdependencies.	Explain	Understand – Level 2
CS503.CO2	Apply lexical and syntax analysis techniques to recognize tokens and parse grammar.	Apply	Apply – Level 3
CS503.CO3	Analyze syntax-directed translation schemes and type-checking mechanisms.	Analyze	Analyze – Level 4
CS503.CO4	Evaluate storage organization, runtime environments, and memory allocation strategies.	Evaluate	Evaluate – Level 5
CS503.CO5	Design intermediate code representations and code optimization techniques.	Design	Create – Level 6
CS503.CO6	Implement basic code generation strategies, including register allocation and instruction selection.	Implement	Create – Level 6

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	-	-	-	-	3	3

8. Mapping of the Course Outcomes to Program Outcomes

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

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS503.CO1	2	1	—
CS503.CO2	3	2	—
CS503.CO3	3	2	—
CS503.CO4	2	2	—
CS503.CO5	3	3	—
CS503.CO6	3	3	—

***** End of Syllabus<CS503>*****

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

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:**
   i. Understand the fundamentals of AI.
   ii. Apply search techniques for problem-solving.
   iii. Develop knowledge representation and reasoning models.
   iv. Explore AI applications in Natural Language Processing.
   v. 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: Physical Vision-Language Models, On-Device AI Agents, AI technique - Search, knowledge representation, learning, reasoning, Tic - Tac - Toe problem. Intelligent Agents [2]: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. 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). 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.	10

3	Adversarial search: 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.	3
4	Knowledge & reasoning [3] Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.	3
5	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
6	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

5. References:

Text & References Books:

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

6. Course Outcomes:

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

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS504.CO1	Understand the fundamentals of AI and analyze intelligent agents and their interactions with environments.	Understand Analyze	L2, L4
CS504.CO2	Apply search strategies for problem solving	Apply, Evaluate	L3, L5
CS504.CO3	Utilize knowledge representation and reasoning techniques	Apply	L3
CS504.CO4	Develop models by implementing learning algorithms	Implement, Develop	L6
CS504.CO5	Understand Natural Language Processing and expert systems	Understand	L2
CS504.CO6	Evaluate AI applications and ethical considerations	Evaluate	L5

7. 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

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	2	3	2	2	-	-	-	-	-	-	-
CO3	3	2	3	-	2	-	-	-	-	-	-
CO4	-	-	2	2	3	2	-	-	-	-	2
CO5	-	2	-	3	-	-	-	-	-	-	2
CO6	-	-	-	-	-	2	3	3	-	-	3
AVG.	**2.67**	**2.25**	**2.33**	**2.33**	**2.50**	**2.00**	**3.00**	**3.00**	**0.00**	**0.00**	**2.00**

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS504.CO1	2	1	1
CS504.CO2	3	1	—
CS504.CO3	3	1	—
CS504.CO4	3	3	2
CS504.CO5	2	1	1
CS504.CO6	2	1	2

***** End of Syllabus*** < CS504 >**

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:**
   - Data Structure and Algorithms
   - 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). Distance Metrics: Examples and four axioms.	5
4	Classification: k-Nearest Neighbors, Naïve Bayes, Decision Tree, Random Forests, Support Vector Machines, Rule-based classification. 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

8	Introduction of Big Data, Basic concepts of- Hadoop ecosystem, HDFS for scalable storage, MapReduce for distributed data processing, YARN for resource management, Hive for SQL-like querying, and Spark for memory processing.	2

5. References:

Text & References Books:

- Data Mining Techniques, by Arun K Pujari.
- Data Mining Concepts and Techniques, by Jiawei Han and M Kamber.
- Introduction to Data Mining, by Pang-Ning Tan and Vipin Kumar.

6. 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	L2
CS505.CO2	Analyze and design various pattern extraction techniques on the association, classification, and clustering of data.	Analyze and design	L4
CS505.CO3	Understand the mining of text data, time series data and stream data.	Understand	L2
CS505.CO4	Understand graph mining and web mining.	Understand	L2
CS505.CO5	Apply data mining techniques for solving real-life problems in various domains.	Apply	L3
CS505.CO6	Understand big data infrastructure essential for large-scale data mining applications.	Understand	L2

7. 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	3	-	-
7	-	-	-	3	3	-
8	-	-	-	-	-	3

8. Mapping of the Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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**	**3.0**

9. Mapping to PSO

Course Outcome	PSO1	PSO 2	PSO 3
CS505.CO1	2	1	1
CS505.CO2	3	2	1
CS505.CO3	2	1	1
CS505.CO4	2	1	1
CS505.CO5	3	2	2
CS505.CO6	2	2	2

***** End of Syllabus*** <CS505>**

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

……

1. **Course Prerequisite:**
   …

2. **Course Learning Objectives:**
   i. …
   ii. .

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. Hidden surfaces [3L]: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden	6L

	line elimination, wire frame methods , fractal - geometry. Color & shading models [2L]: Light & color model; interpolative shading model; Texture. Introduction to Ray-tracing: [3L] Human vision and color, Lighting, Reflection and transmission models.	

5. References:

Text & References Books:

- Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson educationZ. Xiang, R.
- Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
- D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH

6. 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
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**

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			
CO6			

***** End of Syllabus*** < CS506>**

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

1. **Course Prerequisite:**
   - Fundamentals of Computer Organization & Architecture
   - Basic knowledge of Digital Logic Design
   - 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.

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

5. **References:**

- Hwang, K., Jotwani, N., Advanced Computer Architecture, Tata McGraw Hill.
- Patterson, D.A., Hennessy, J.L., Computer Organization & Design, Morgan Kaufmann.
- Flynn, M.J., Computer Architecture: Pipelined and Parallel Processor Design, Narosa.
- Stallings, W., Computer Organization & Architecture: Designing for Performance, PHI.
- Tanenbaum, A.S., Structured Computer Organization, PHI.
- Noergaard, T., Embedded Systems Architecture: A Comprehensive Guide, Elsevier.

6. 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	L2
CS-507.CO2	Analyze instruction pipelining and hazard resolution techniques	Analyze	L2
CS-507.CO3	Compare memory hierarchy and evaluate cache coherence techniques	Compare	L1
CS-507.CO4	Design efficient parallel computing and multicore architectures	Design	L4
CS-507.CO5	Develop FPGA-based reconfigurable architectures	Develop	L4
CS-507.CO6	Explore emerging trends like quantum and cloud computing	Explore	L1

7. 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

8. Mapping of the Course outcomes to Program Outcomes

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

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS-507.CO1	2	1	—
CS-507.CO2	3	1	—
CS-507.CO3	2	1	—
CS-507.CO4	3	2	2
CS-507.CO5	2	2	2
CS-507.CO6	2	2	3

***** End of Syllabus*** < CS507>**

Course Name: Distributed Database Management System

Course Code: CS508

(Semester- V)

Category: Major

Course Broad Category: Engineering Science Course

[For Computer Science and Engineering]

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1. **Course Prerequisite:**
   Database Management Systems

2. **Course Learning Objectives:**
   i. 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 problems to equip students with knowledge and practical skills essential for understanding modern computing systems and networks.

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: 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 (OS): Role and Types (CLI-based OS, GUI-based OS), Mobile OS and Network OS.	8L
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

5. References:

Text & References Books:

- Principles of Distributed Database Systems, M.T. Ozsu and P Valduriez, Prentice-Hall, 1991.
- Distributed Database Systems, D. Bell and J. Grimson, Addison Wesley, 1992.

6. Course Outcomes:

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

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Design trends in distributed systems.		
CO2	Apply network virtualization.		
CO3	Apply remote method invocation and objects.		

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
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**

9. Mapping to PSO

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

***** End of Syllabus*** <CS508>**

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

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

2. **Course Learning Objectives:**
   i. 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.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.
   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: Linear Algebra and 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 linear transformation and isomorphism, matrix representation of linear transformations – some examples and related theorems. Inner products, norms, orthonormal bases, spectral theorem, unitary and orthogonal transformations.	14L
3.	Numerical solution of a system of linear equations: 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. 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. 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. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS515.1	Ability to understand the basic concepts of vector and matrix algebra, including linear dependence / independence, basis and dimension of a subspace, for analysis of matrices and systems of linear equations	Identify	Remember
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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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)

Course Outcome	PSO1	PSO2	PSO3
CS515.CO1	1	—	—
CS515.CO2	1	—	—
CS515.CO3	2	—	—
CS515.CO4	2	—	—
CS515.CO5	2	—	—
CS515.CO6	1	—	1

***** End of Syllabus*** <CS515>**

Course Name: Economics for Engineers

Course Code: CS516

(Semester- V)

Category: Open Elective I

Course Broad Category: Engineering Science Course

[For Computer Science and Engineering]

1. **Course Prerequisite:**

2. **Course Learning Objectives:**
   i. To enable students to understand the economics principles applicable to engineering.
   ii. To learn the techniques of economic decision making.
   iii. To familiarize the students with basic fundamentals of Indian financial economy.

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: Economics for Engineers
   Course Code: CS516
   Hours per Week: 3L
   Credits: 3

Module	Topics	Lectures
Unit 1	Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models – Per Unit Model, Segmenting Model, Cost Indexes, Power Sizing Model, Improvement & Learning Curve, Benefits.	8
Unit 2	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal& Effective Interest. Cash Flow & Rate of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity and Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits &drawbacks	9
Unit 3	Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, and Risk vs Return, Simulation, Real Options.	8
Unit 4	Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight Line Depreciation Declining Balance Depreciation, Common	8

	Elements Of Tax Regulations For Depreciation And Capital Allowances. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	

5. References:

Text & References Books:

- James L.Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
- Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP
- John A. White, Kenneth E. Case, David B. Pratt : Principle of Engineering Economic Analysis, John Wiley
- Sullivan and Wicks: Engineering Economy, Pearson
- R.Paneer Seelvan: Engineering Economics, PHI
- Michael R Lindeburg : Engineering Economics Analysis, Professional Pub
- Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House

6. Course Outcomes:

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

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Make different economic decisions and estimate engineering costs by applying different cost estimation models	Apply	L3
CO2	Understand the concepts of depreciation and replacement analysis and solve associated problems, process of inflation and use different price indices to adjust for its effect and also the scope of Finance and the role of financial planning and management.	Understand	L2
CO3	Apply the various concepts of Accounting like balance sheet and ratio analysis.	Apply	L3
CO4	Take decisions regarding different engineering projects by using various criteria like rate of return analysis, present worth analysis, cost-benefit analysis etc.	Apply	L3
CO5	Create cash flow diagrams for different situations and use different interest formulae to solve associated problems.	Create	L6

7. Mapping of course outcomes to module / course content

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

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1											
CO2											
CO3											

CO4											
CO5											
AVG.											

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS516.CO1	—	—	—
CS516.CO2	—	—	—
CS516.CO3	—	—	—
CS516.CO4	—	—	—
CS516.CO5	—	—	—

***** End of Syllabus*** < CS516>**

Course Name: Open Elective I: Multimedia System

Course Code: CS517

(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: 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 Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing. Case study of Applications	17L
Unit 5:	Multimedia Applications(4L): Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, mediaeditors	4L

5. **References:**
   Text & References Books:

6. **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	L1
CS517.CO2	Understand the standards available for different audio,video Image and text applications	Understand	L2
CS517.CO3	Design various available storage model for multimedia and can give a comparison study between them.	Design	L3
CS517.CO4	Compare between different available multimedia document architecture.	Compare	L4
CS517.CO5	Explain technical aspects of popular multimedia web applications, including VoD and VoIP	Explain	L5
CS517.CO6	Develop multimedia application and analyze the performance of the same	Develop	L6

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
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**

9. **Mapping to PSO**

Course Outcome	PSO1	PSO2	PSO3
CS517.CO1	—	—	—
CS517.CO2	—	—	—
CS517.CO3	—	—	—
CS517.CO4	—	—	—
CS517.CO5	—	—	—
CS517.CO6	—	—	—

***** End of Syllabus*** <CS517>**

Course Name: Augmented Reality, Virtual Reality

Course Code: CS518

(Semester – V)

Category: Major

Course Broad Category: Engineering Science Course

[For Computer Science and Engineering]

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1. **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

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: 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

5. **References:**

Text & References Books:

- Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience,India, 2003.
- LaValle "Virtual Reality", Cambridge University Press, 2016, edition, 2009.
- Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, and Ivan Poupyrev, 3D User Interfaces,Addison-Wesley, 2005.
- K. S. Hale and K. M. Stanney, Handbook on Virtual Environments, 2nd edition, CRC Press,2015.
- Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005

- Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D UserInterfaces, Theory and Practice", Addison Wesley, USA, 2005.
- 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
CS518.CO1	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
CS518.CO2	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
CS518.CO3	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
CS518.CO4	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
CS518.CO5			
CS518.CO6			

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
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-
CO3	3		2	-	-	-	-	-	-	-	-
CO4		-	-	-	-	2	-	-	-	-	-
CO5	-	3	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	-	3
AVG.	**3.00**	**2.67**	**2.00**	**2.00**	**3.00**	**2.00**	**0.00**	**0.00**	**3.00**	**0.00**	**3.00**

9. Mapping to PSO

Course Outcome	PSO1	PSO 2	PSO 3
CS518.CO1	2	2	2
CS518.CO2	1	2	2
CS518.CO3	2	2	3
CS518.CO4	2	2	2
CS518.CO5	-	-	-
CS518.CO6	-	-	-

***** End of Syllabus*** < CS518>**

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:**
   i. .
   ii. .

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

5. **References:**
   Text & References Books:
   - Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.

- Operating Systems: Internals and Design Principles, 5th Edition, WilliamStallings, Prentice Hall of India.

6. Course Outcomes:

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

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS591.CO1	Operates on UNIX / Linux operating systems with various shell commands, including different kernel-level activities.	Understand	L2
CS591.CO2	Understanding of shell script.	Understand	L2
CS591.CO3	Implement synchronization using semaphore and thread.	Implement	L3
CS591.CO4	Implement different types of process and thread.	Understand	L2
CS591.CO5	Implement the concept of pipes for improving the efficiency of an operating system in terms of speed up and throughput.	Implement	L3

7. 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

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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**	**2.5**	**2**						

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS591.CO1	2	2	—
CS591.CO2	1	2	—
CS591.CO3	2	2	—
CS591.CO4	2	2	—
CS591.CO5	2	2	—

***** End of Syllabus*** <CS591>**

Course Name: Software Engineering Lab

Course Code: CS-592

(Semester-V)

Category: Major

Course Broad Category: Engineering Science Course

[For Computer Science and Engineering]

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1. **Course Prerequisite:**
   Object Oriented Programming
   Database Management Systems
   Problem Analysis and Project Planning –Thorough study of the problem.

2. **Course Learning Objectives:**
   Understand the software engineering methodologies
   Design software projects
   Develop software projects
   Apply appropriate testing methods

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: CS592
   Hours per Week: 3L: 0T: 0P
   Credits: 3L

Module	Topics	Lectures
1	Problem Analysis and Project Planning -Thorough study of the problem – Identify Project scope,Objectives and Infrastructure.	4
2	Software Requirement Analysis – Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.	4
3	Data Modeling – Use work products – data dictionary	4
4	Software Designing - Develop use case diagrams and activity diagrams, build and testclass diagrams,sequence diagrams and add interface to class diagrams.	2
5	Prototype model – Develop the prototype of the product The SRS and prototype model should be submitted for end semester examination.	4
6	One mini-project (comprising 4-5 students) based on industry-relevant software project.	6

5. **References:**
   Text & References Books:

6. **Course Outcomes:**
   After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS592.CO1	Understand the software engineering methodologies involved in the phases for project development.	Understand	L2
CS592.CO2	Extract functional and non-functional requirement for given problem statement.	Extract	L2
CS592.CO3	Choose between different design strategies for real life problem.	Choose	L4
CS592.CO4	Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.	Develop	L3
CS592.CO5	Design Test Script/Test Plan using Black box and White Box approach.	Design	L3
CS592.CO6	Evaluate Process and Product Metrics using different models.	Evaluate	L5

7. 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

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-
CO3	3	-	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2	-	-	-	-	-
CO5	-	3	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	3	-	-	3
AVG.	**3.0**	**2.67**	**2**	**2**	**3**	**2.0**	**0.0**	**3**	**0.0**	**0.0**	**3**

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS592.CO1	2	2	—
CS592.CO2	2	2	—
CS592.CO3	2	3	—
CS592.CO4	2	3	—
CS592.CO5	2	3	—
CS592.CO6	2	2	—

***** End of Syllabus*** < CS592>**