Book:

1. Abraham Silberscatz, Peter Baer Galvin and Greg Gagne, " Operating System Concepts ", 7th Ed John Wiley and Sons, Inc 2005.
2. William Stallings, "Operating Systems: Internals and design Principles", 5th Ed Prentice –hall, 2005.
3. Andrew Tanenbaum, "Modern operating systems" 3rd Ed, Pearson Education.

Lab Exercise: CSC454 Practical based on CSC404
At least two experiments should carried out on each unit.

Subject Reference No	CSC405	Subject Title	Data Structure and Analysis of Algorithm
No of Credits	4 Theory, 2Practical	Assignment/ Sectionals (Internal)	20%
Total Contact Hrs/Week	4 Theory, 4 Practical	External (Semester Exam)	80%

Objective: This course provides an introduction to mathematical modeling of computational problems. It covers the common algorithms, algorithmic paradigms, and data structures used to solve these problems. The course emphasizes the relationship between algorithms and programming, and introduces basic performance measures and analysis techniques for these problems.

Prerequisite: Programming language concepts, discrete mathematical structure.

UNIT I:
Overview: Introduction to Algorithm, Analysis of algorithm, Designing of algorithm, the Correctness of Algorithms and the Complexity of Algorithms

UNIT II:
Linear Data Structures: Stack, Queue, Array, Linked list, Priority Queue, Deque, Doubly linked list, circular linked list **Searching and sorting Techniques**
Test1: Part 1, 2 and 3

UNIT III:
Graphs: Introduction to Graph Theory, Graph isomorphism, Graph data structures: Adjacency lists,Adjacency matrices Elementary graph Algorithms: BFS, DFS, Topological sort, strongly connected components **Trees:** Introduction to Trees, Tree traversals (preorder, inorder and postorder), Binary trees, **Balanced trees:** Avl etc., B and B+ tree Application of trees, Minimum Spanning Trees, Single source shortest path, All pair shortest path.
Test1: Part 4 and 5

UNIT IV:
Strings: The string abstract data type, Brute force string pattern matching, regular expression pattern matching, finite automata **Hashing** : Hash function, collision resolution, Heap

UNIT V:

Dynamic programming and greedy algorithms NP vs P: The spaces P and NP, polynomial reduction, NP complete problem **Final Exam: Total syllabus**

Book:
1) "Introduction to Algorithms", Thomas Cormen.
2) "Data structures and Algorithms", Alfred V.Aho,
3) "Fundamentals of Data Structures in c++", Ellis Horowitz.

Lab Exercise: CSC455 Practical based on CSC405
At least two experiments should carried out on each unit.

Subject Reference no	CSC406	Subject Title	Advanced Neural Network and Fuzzy System
No of Credits	4 Theory, 2 Practical	Assignment/ Sectionals (Internal)	20%
Total Contact Hrs/Week	4 Theory, 4 Practical	External (Semester Exam)	80%

Objective: Modeling and deployment of the applications through Neural Networks, Fuzzy and Genetic algorithms.

Prerequisite:

UNIT I:
Dynamic Systems Review: States, State Vectors and Dynamics, State Equations, Attractors And Stability, Linear Dynamical Systems, Non-Linear Dynamical Systems, Lyapunov Stability, Neurodynamical Systems, The Cohen-Grossberg Theorem

UNIT II:
Attractor Neural Networks: Introduction, Associative Learning, Attractor Neural Network Associative Memory, Linear Associative Memory, Hopfield Network, Content Addressable Memory, Two Handworked Examples, Example of Recall of Memories in Continuous Time, Spurious Attractors, Error Correction with Bipolar Encoding, Error Performance of Hopfield Networks, Applications of Hopfield Networks, Brain-State-in-a-Box Neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory, Handworked Example, BAM Stability Analysis, Error Correction in BAMs, Memory Annihilation of Structured Maps in BAMs, Continuous BAMs, Adaptive BAMs, Application: Pattern Association,

UNIT III:
Adaptive Resonance Theory: Noise-Saturation Dilemma, Solving the Noise-Saturation Dilemma, Recurrent On-Center-Off-Surround Netowrks, Building Blocks of Adaptive Resonance, Substrate of Resonance, Structural Details of the Resonance Model, Adaptive Resonance Theory I (ART I), Handworked Example, MATLAB Code Description, A Breezy Review of ART Operating Principles, Neurophysiological Evidence for ART Mechanisms, Applications

UNIT IV:
Self-Organizing Feature Map: Self Organization, Maximal Eigenvector Filtering, Extracting Principal Components: Sanger's Rule, Generalized Learning Laws, Competitive Learning Revisited, Vector Quantization, Mexican Hat Networks, Self Organizing Feature Maps, Applications of the Self Organizing Map

UNIT V:

Pulsed Neuron Models; The New Generation: Introduction, Spiking Neuron Model, Integrate-and-Fire Neurons, Conductance Based Models, Computing with Spiking Neurons, Reflections, **Fuzzy Sets, Fuzzy Systems and Application:** Need for Numeric and Linguistic Processing, Fuzzy Uncertainty and the Linguistic Variable, Fuzzy Set, Membership Functions, Geometry of Fuzzy Sets, Simple Operations on Fuzzy Sets, Fuzzy Rules for Approximate Reasoning, Rule Composition and Deffuzification, Fuzzy Engineering

Neural Networks and the Soft Computing Paradigm: Soft Computing= Neural + Fuzzy + Evolutionary, Neural Networks: A Summary, Genetic Algorithms, Neural Networks and Fuzzy Logic, Neuro-Fuzzy-Genetic Integration

BOOKS:

1. Neural Network- A Classroom Approach, Satish Kumar, Tata McGraw Hill
2. Introduction to neural networks using MATLAB 6.0 by Sivanandam, S Sumathi, S N Deepa, TATA McGraw HILL

REFERENCES:

1. Neural networks A comprehensive foundations, Simon Hhaykin, Pearson Education 2nd edition 2004
2. Artificial neural networks - B.Yegnanarayana, Prentice Hall of India P Ltd 2005.
3. Neural networks in Computer intelligence, Li Min Fu, TMH 2003.
4. Neural networks James A Freeman David M S kapura, Pearson education 2004.
5. C++ Neural Network and Fuzzy Logic 2nd Edition, Valluru B. Rao,Hayagriva V. Rao, Henry Holt and Co.
6. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence, Bart Kosko,

Lab Exercise: CSC456 Practical based on CSC406

At least two experiments should carried out on each unit.

Subject Reference no	CSC407	Subject Title	Image Processing
No of Credits	4 Theory, 2 Practical	Assignment/ Sectionals (Internal)	20%
Total Contact Hrs/Week	4 Theory, 4 Practical	External (Semester Exam)	80%

Objective: The course begins with low level processing and works its way up to the beginnings of image interpretation. This approach is taken because image understanding originates from a common database of information. The learner will be required to apply their understating of the concepts involved through the process of building applications that manipulate bi-level and gray scale images through the use of suitable packages (e.g. MATLAB).

Prerequisite: To learn this course basic knowledge of Digital Signal Processing, Mathematics and Statistical Techniques is must.

Unit 1: Image Processing Fundamentals: Digital image, digital image processing, History of digital image processing, State of the art examples of digital image processing, Key stages in digital image processing, The human visual system, Light and the electromagnetic spectrum, Image representation, Image sensing and acquisition, Sampling, quantisation and resolution.

Unit 2: Image Enhancement (Histogram Processing, Point Processing and Spatial Filtering): image enhancement, Different kinds of image enhancement, Histogram processing, Point processing, Neighbourhood operations, Negative images, Thresholding, Logarithmic transformation, Power law transforms, Grey level slicing, Bit plane slicing, Neighbourhood operations, spatial filtering, Smoothing operations, What happens at the edges?, Correlation and convolution, Sharpening filters, 1st derivative filters, 2nd derivative filters, Combining filtering techniques.

Unit 3: Image Enhancement (Frequency Filtering): Jean Baptiste Joseph Fourier, The Fourier series & the Fourier transform, Image Processing in the frequency domain, Image smoothing, Image sharpening, Fast Fourier Transform

Unit 4: Image Restoration (Noise Removal): image restoration, Noise and images, Noise models, Noise removal using spatial domain filtering, Periodic noise, Noise removal using frequency domain filtering,

Unit 5: Segmentation, Morphology and color (Points, Lines, Edges & Thresholding): The segmentation problem, Finding points, lines and edges, thresholding, Simple thresholding, Adaptive thresholding, morphology, Simple morphological operations, Compound operations, Morphological algorithms, Colour fundamentals, Colour models.

Text Book

1. Digital Image Processing, 3/e, Rafael C. Gonzalez, Richard E. Woods. Pearson Education, ISBN: 9788131726952

Lab Exercise: CSC457 Practical based on CSC407
At least two experiments should be carried out on each unit.

Subject Reference no	CSC408	Subject Title	Parallel Computing
No of Credits	4 Theory, 2 Practical	Assignment/ Sectionals (Internal)	20%
Total Contact Hrs/Week	4 Theory, 4 Practical	External (Semester Exam)	80%

Course Objective: the objective of this course is to make student aware of entirely new paradigm of parallel programming and computing.

Prerequisite: Programming Language Concepts, Threading and Concepts of Operating Systems.

UNIT I:

Introduction to Parallel Computing: Motivating Parallelism, The Computational Power Argument - from Transistors to FLOPS, The Memory/Disk Speed Argument, The Data Communication Argument, Scope of Parallel Computing, Applications in Engineering and Design, Scientific Applications, Commercial Applications, Applications in Computer Systems, Organization and Contents of the Text, **Parallel Programming Platforms:** Implicit Parallelism: Trends in Microprocessor Architectures, Pipe lining and Superscalar Execution, Very Long Instruction Word Processors, Limitations of Memory System Performance*, Improving Effective Memory Latency Using Caches, Impact of Memory Bandwidth, Alternate Approaches for Hiding Memory Latency, Tradeoffs of Multithreading and Prefetchin, Dichotomy of Parallel Computing Platforms, Control Structure of Parallel Platforms, Communication Model of Parallel Platforms, Physical Organization of Parallel Platforms, Architecture of an Ideal Parallel Computer, Interconnection Networks for Parallel Computers, Network Topologies, Evaluating Static Interconnection Networks, Evaluating Dynamic Interconnection Networks, Cache Coherence in Multiprocessor Systems, Communication Costs in Parallel Machines, Message Passing Costs in Parallel Computers, Communication Costs in Shared-Address-Space Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques,Mapping Techniques for Graphs, Cost-Performance Tradeoffs

UNIT II:

Principles of Parallel Algorithm Design: Preliminaries, Decomposition, Tasks, and Dependency Graphs, Granularity, Concurrency, and Task-Interaction, Processes and Mapping, Processes versus Processors, Decomposition Techniques, Recursive Decomposition, Data Decomposition, Exploratory Decomposition, Speculative Decomposition, Hybrid Decompositions, Characteristics of Tasks and Interactions, Characteristics of Tasks, Characteristics of Inter-Task Interactions, Mapping Techniques for Load Balancing, Schemes for Static Mapping, Schemes for Dynamic Mapping,Methods for Containing Interaction Overheads, Maximizing Data Locality, Minimizing Contention and Hot Spots, Overlapping Computations with Interactions, Replicating Data or Computations, Using Optimized Collective Interaction Operations, Overlapping Interactions with Other Interactions, Parallel Algorithm Models, The Data-Parallel Model, The Task Graph Model, The Work Pool Model, The Master-Slave Model, The Pipeline or Producer-Consumer Model, Hybrid Models, **Basic Communication Operations:**One-to-All Broadcast and All-to-One Reduction, Ring or Linear Array, Mesh, Hypercube, Balanced Binary Tree Detailed Algorithms, Cost Analysis, All-to-All Broadcast and Reduction, Linear Array and Ring, Mesh, Hypercube, Cost Analysis, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Ring, Mesh, Hypercube, Circular Shift, Mesh, Hypercube, Improving the Speed of Some Communication Operations, Splitting and Routing Messages in Parts, All-Port Communication,

UNIT III:

Analytical Modeling of Parallel Programs: Performance Metrics for Parallel Systems, Execution Time, Total Parallel Overhead, Speedup,Efficiency,Cost, The Effect of Granularity on Performance, Scalability of Parallel Systems, Scaling Characteristics of Parallel Programs, The Isoefficiency Metric of Scalability, Cost-Optimality and the Isoefficiency Function, A Lower Bound on the IsoefficiencyFunction,The Degree of Concurrency and the Isoefficiency Function, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics, **Programming Using the Message-Passing Paradigm:** Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations , Blocking Message Passing Operations,Non-Blocking Message Passing Operations, MPI: the Message Passing Interface, Starting and Terminating the MPI Library, Communicators, Getting Information, Sending and Receiving Messages, Example: Odd-Even Sort, Topologies and Embedding, Creating and Using Cartesian Topologies, Example: Cannon's Matrix-Matrix Multiplication, Overlapping Communication with Computation , Non-Blocking Communication Operations, Collective Communication and Computation Operations, Barrier , Broadcast, Reduction, Prefix, Gather, Scatter, All-to-All, Example: One-Dimensional Matrix- Vector Multiplication, Example: Single-Source Shortest-Path, Example: Sample Sort, Groups and

Communicators, Example: Two-Dimensional Matrix- Vector Multiplication,

UNIT IV:

Programming Shared Address Space Platforms: Thread Basics, Why Threads? The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads, Mutual Exclusionfor Shared Variables, Condition Variables for Synchronization, Controlling Thread and Synchronization Attributes, Attributes Objectsfor Threads, Attributes Objects for Mutexe, Thread Cancellation, Composite Synchronization Constructs, Read-Write Locks, Barriers, Tips for Designing Asynchronous Programs, OpenMP: a Standard for Directive Based Parallel Programming, The OpenMP Programming Model, Specifying Concurrent Tasks in OpenMP, Synchronization Constructs in OpenMP, Data Handling in OpenMP, OpenMP Library Functions, Environment Variables in OpenMP, Explicit Threads versus OpenMP Based Programming **Dense Matrix Algorithms:** Matrix- Vector Multiplication,Rowwise 1-D Partitioning, 2-D Partitioning, Matrix-Matrix Multiplication, A Simple Parallel Algorithm,Cannon's Algorithm, The DNS Algorithm, Solving a System of Linear Equations, A Simple Gaussian Elimination Algorithm, Gaussian Elimination with Partial Pivoting, Solving Q Triangular System: Back-Substitution, Numerical Considerations in Solving Systems of Linear Equations**Sorting:** Issues in Sorting on Parallel Computers, Where the Input and Output Sequences are Stored,How Comparisons are Performed, Sorting Networks, Bitonic Sort, Mapping Bitonic Sort to a Hypercube and a Mesh Bubble Sort and its Variants, Odd-Even Transposition, Shellsort,Quicksort, Parallelizing Quicksort, Parallel Formulationfor a CRCW PRAM, Parallel Formulationfor Practical Architectures, Pivot Selection,Bucket and Sample Sort,Other Sorting Algorithms, Enumeration Sort,Radix Sort.

UNIT V:

Graph Algorithms: Single-Source Shortest Paths: Dijkstra's Algorithm**Search Algorithms for Discrete OptimizationProblems:** Definitions and Examples,Sequential Search Algorithms, Depth-First Search Algorithms, Best-First Search Algorithms, Search Overhead Factor, Parallel Depth-First Search, Important Parameters of Parallel DFS, A General Frameworkfor Analysis of Parallel DFS, Analysis of Load-Balancing Schemes, Termination Detection, Experimental Results, Parallel Formulations of Depth-First Branch-and-Bound Search,Parallel Formulations of IDA *, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms, Analysis of Average Speedup in Parallel DFS **Dynamic Programming:** Overview of Dynamic Programming, Serial Monadic DP Formulations, The Shortest-Path Problem, The Oil Knapsack Problem, Nonserial Monadic DP Formulations, The Longest-Common-Subsequence Problem, Serial Polyadic DP Formulations, Floyd's All-Pairs Shortest-Paths Algorithm, NonserialPolyadic DP Formulations, The Optimal Matrix-Parenthesization Problem, **Fast Fourier Transform:** The Serial Algorithm, The Binary-Exchange Algorithm, A Full Bandwidth Network, Limited Bandwidth Network, Extra Computations in Parallel FFT, The Transpose Algorithm, Two-Dimensional Transpose Algorithm, The Generalized Transpose Algorithm

Books:

1. Introduction to Parallel Computing, AnanthGrama, Pearson Education

References:

1. Fundamental of Paralle Processing, Harry F. Jordan, Gita Alaghband, Pearson Education
2. Parallel Programming, Michael Allen, Barry Wilkinson, Pearson Education

Lab Exercise: CSC458 Practical based on CSC408

At least two experiments should carried out on each unit.