Paper Code – ~~CSM101~~ CSMC103 **Paper Name – Advances in Computer Architecture**		**Full Marks: 100**
Module	**Topics**	**Lecture Hours**
Module-1: **Introduction**	Computer Architecture & Organization. Basic Parallel Processing Architecture, Taxonomy- SISD. MISD, SIMD, MIMD structures, Serial, Parallel & Concurrent Computation, CISC vs RISC, Structure of Instruction of instruction sets and Desirable Attributes.	6
Module-2: **Pipelining**	Basic Concepts of pipelining, Instruction Pipelining. Hazards, Reservation Tables, Collision, Latency, Dynamic pipeline, Vector processing & Vector processors.	6
Module-3: **Memory Systems**	Cache Memory & Virtual Memory: Structure, Analysis & Design.	4
Module-4: **I/O Systems**	Design Issues, Performances Measures.	2
Module-5: **Multiprocessor Architecture**	Loosely Coupled & Tightly Coupled Systems, Concurrency & Synchronization, Scalability, Models of Consistency, Application of SIMD Structure.	3
Module-6: **Interconnection Network**	Definition. Types of Interconnected Networks; Baselines, Shuffle- Exchange, Omega, Cuba, Comparison & Application.	5
Module-7: **Systolic Architecture**	Systolic processor, Mapping Algorithm to array structures, Mapping design & Optimization, Systolization Procedure	5
Module-8: **Data Flow Architecture**	Data Flow Architecture, Different forms of DFA, Data Flow Graphs, Petri nets	3
Module-9: **Programming Environment**	Different Models, Languages, Compilers, dependency Analysis. Message Passing, Program mapping to Multiprocessors, Synchronization	4
Module-10: **Case Study**	Basic Features of Current Architectural Trends. DSP Processor, Multicore Technology	2

Text book:

1. John L. Hennessey and David A. Patterson, “Computer Architecture A Quantitative Approach”, Morgan Kaufmann/ Elsevier, Fifth Edition, 2012.
2. Kai Hwang and Faye Briggs, “Computer Architecture and Parallel Processing”, Mc Graw-Hill International Edition, 2000.

Syllabus for Object Oriented Systems

Learning Objective:

- To understand the basics of Class and Object Modeling.
- To design with static UML diagrams
- To design with dynamic UML diagrams
- To understand how to create reusable design with design patterns

Paper Code – CSMC104 **Paper Name – Object Oriented Systems**		**Full Marks: 100**
Module	**Topics**	**Lecture Hours**
Module-1: **Object Oriented Programming Concepts**	Abstraction and Encapsulation, Generalization and Specialization, Functional Decomposition and Object Oriented Decomposition, Coupling and Cohesion, Modularity and Hierarchy, Relationships among Classes, Relationships among Objects, Identification of Classes, Objects and Relationship, Dynamic Dispatch and Dynamic Binding, Generic Programming	8
Module-2: **Object Oriented Analysis and Design with UML**	Overview of UML, SDLC Phases and UML Diagrams, **Static UML(Structural) Diagrams:** Class Diagrams, Object Diagram, Component Diagram, Package Diagram, Composite Structure Diagram **Dynamic UML(Behavioral) Diagrams:** Activity Diagram, Use Case Diagram, State Machine Diagram, Sequence Diagram, Communication Diagram, Interaction Overview Diagram	12
Module-3: **Design Patterns for reusable Object Oriented Designs**	Design Pattern basics, Benefits of using Design Pattern, **Creational Pattern:** Reflections, Singleton, Object Pool, Factory, Abstract Factory, Builder, Prototype **Structural Pattern:** Adapter, Bridge, Composite, Decorator, Flyweight, Facade, Proxy **Behavioral Pattern:** Interpreter, Template Method, Chain of Responsibility, Command, Iterator, Mediator, Memento, Observer, State, Visitor, Strategy	20

Textbook:

1. Object-Oriented Software Development Using Java. Xiaoping Jia. Addison Wesley, ISBN 0-201-73733-7.

References:

2. Head First Object-Oriented Analysis and Design. Brett D. McLaughlin, Gary Pollice, and Dave West. O’Reilly.
3. Head First Design Patterns. Eric Freeman and Elizabeth Freeman. O’Reilly.

Syllabus for Data Structures and Algorithms

Learning Objective:

- To understand a few advanced data structures.
- To understand different algorithm paradigms.
- To apply the appropriate data structures in different algorithms.
- To apply the algorithm design paradigm for different problems.
- To analyze the space and time complexity of any algorithm.
- To understand the complexity class of different problems.
- To apply different techniques to handle NP-Completeness.

Paper Code – CSMC102 **Paper Name – Data Structures and Algorithms**		**Full Marks: 100**
Module	**Topics**	**Lecture Hours**
Module-1: **Advanced Data Structures**	**Review of Basic Data Structures:** Stacks, Queues, Arrays, Linked lists, BST, AVL tree, Red-Black tree, Hashing. **External Memory Data Structures:** B-tree, B*-tree. **Sorting:** Comparison based and tree structure based sorting algorithms. **Dictionary and Priority Queue:** Heap, Binomial heaps, Fibonacci heaps. **Set Manipulation:** Disjoint Set Data Structures-Union find algorithm.	16
Module-2: **Algorithm Design Paradigms**	**Amortized Analysis of Algorithms:** Comparison with asymptotic notations, Credit balance, Amortized cost. **Greedy Algorithm:** Activity scheduling, Huffman encoding, Greedy algorithms on matroids. **Divide and Conquer:** Selection algorithm, Integer multiplication. **Dynamic Programming:** Longest common subsequence, Optimal binary search tree	6
Module-3: **NP-Completeness**	**Complexity Classes:** P and NP, Cook's theorem, Reducibility, NP-completeness, NP-hardness. **Some NP-Complete Problems:** 3-SAT, Clique computation, Travelling salesman, Vertex cover, Hamiltonian cycle, 3-Coloring.	6
Module-4: **Coping with NP-Completeness**	**Approximation Algorithm:** Approximation algorithms vs. Approximation schemes, Vertex cover, Travelling salesman, Knapsack, Job-scheduling problems.	6
Module-5: **Network Flow and Matching**	**Maximum Flow Problem:** Flow properties, Max flow-Min cut theorem, Ford-Fulkerson algorithm, Edmond-Karp algorithm. **Matching Problem:** Bipartite matching for weighted and unweighted graphs.	6

Textbooks:

1. Introduction to Algorithms (Third Edition), T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, 2009.
2. Fundamentals of Computer Algorithms (Second Edition), E. Horowitz, S. Sahni, S. Rajasekaran, 2008.
3. Design and Analysis of Computer Algorithms, A. V. Aho, J. E. Hopcroft, and J. D. Ullman, Pearson, 1974.
4. Lecture notes of D. A. Mount, http://www.cs.umd.edu/class/fall2020/cmsc420-0201/Lects/cmsc420-fall2020-lects.pdf

References:

5. Algorithm Design, J. Kleinberg and E. Tardos, Pearson New International Edition, 2005.
6. Algorithms, S. Dasgupta, C. Papadimitriou, and U. Vazirani, Mc-Graw Hill Education (India) Edition, 2006.

Paper Code – CSMC101 Paper Name – Mathematics for Computing		Marks: 100
Module	**Topics**	**Lecture Hours**
Module-1 Recurrence relations and solution methods	Definition of recurrence relations, Formulating recurrence relations, solving recurrence relations-Backtracking method, Linear homogeneous recurrence relations with constant coefficients. Solving linear homogeneous recurrence relations with constant coefficients of degree two, Particular solutions of nonlinear homogeneous recurrence relation, Solution of recurrence relation by the method of generating functions Applications- Formulate and solve recurrence relation for Fibonacci numbers, Tower of Hanoi, Intersection of lines in a plane, Sorting Algorithms.	8
Module-2 Graph theory	Introduction to Graphs & its Applications, Trees, and Distance, Properties of Trees, Spanning Trees and Enumeration, Matrix-tree computation, Cayley's Formula, Matchings and Covers, Min-Max Theorem, Independent Sets, Covers and Maximum Bipartite Matching, Cuts and Connectivity, k-Connected Graphs, Vertex Coloring, Counting Proper Colorings. Planar Graphs, Characterization of Planar Graphs, Kuratowski's Theorem, Large Graph: representation, visualization and processing,	10
Module-3 Matrix	Matrix: Determinant and Trace / Eigenvalues and Eigenvectors / Cholesky Decomposition / Eigen decomposition and Diagonalization / Singular Value Decomposition / Matrix Approximation / Matrix Phylogeny	4
Module-4 Linear Algebra	Systems of Linear Equations / Solving Systems of Linear Equations / Vector Spaces. Linear Independence / Basis and Rank / Linear Mappings / Affine Spaces	4
Module-5 Analytic Geometry	Norms / Inner Products / Lengths and Distances / Angles and Orthogonality / Orthonormal Basis / Orthogonal Complement / Inner Product of Functions / Orthogonal Projections / Rotations	4
Module-6 Probability	Construction of a Probability Space / Discrete and Continuous Probabilities / Sum Rule, Product Rule, and Bayes' Theorem / Summary Statistics and Independence / Gaussian Distribution / Conjugacy and the Exponential Family /Change of Variables / Inverse Transform	10

1. Discrete Mathematics and its Applications, by Kenneth H. Rosen, McGraw-Hill Kenneth H. Rosen, McGraw-Hill
2. Discrete Mathematics, Lecture Notes, Yale University, Spring 1999,L. Lov'asz and K. Vesztergombi Mathematics for Computer Science, Lehman, Leighton & Meyer
3. Online resources complementing the book by Rosen
4. Graph Theory with Applications to Engineering & Computer Science : NARSINGH DEO
5. R. Ash & C. Doleans-Dade : Probability and Measure Theory
6. A. K. Basu : Measure Theory and Probability
7. G. Hadley : Linear Algebra

CSMC 201: Advanced Database Management System

TOPICS	HOURS
Relational Database Design: Problem Solving on Normalization & Functional Dependency, Multi-valued Dependencies; Indexing: Cost model of basic file Organizations like Heap file, Sorted file, Hashed file, Need of Indexing and Hashing, Tree Structured Indexing: ISAM, B+ Tree; Hash based Indexing: Static, Extendable, Linear Hashing schemes, Index selection guideline with small use cases.	**8**
Query Processing and Optimization: Query Evaluation: External Sorting, Evaluation of relational Operators (Select & Join) including Join algorithms, Query Optimization: Heuristic based & Cost based optimization, Structure of Query Optimizer with small use case. Database tuning through reframing schema, query, view.	**6**
Concurrency Control and Recovery: Transaction & Schedule, ACID property, Serializabilty, Anomalies with Interleaved execution, Conflict & View serializability, Concurrency Control techniques: Locking and Timestamp based protocols, Multi-version and Validation based schemes, Multiple Granularity locking, Deadlock handling, Crash Recovery: ARIES, Recovery Data structure Log, Write Ahead Logging, Check-pointing, Recovery from a system crash.	**10**
Alternative Data Models: Weakness of RDBMS, Contribution of Object & Object Relational Data Model, Semi Structured and Unstructured Data Handling in Database application: XML Document-DTD-XML Schema, XPath- XQuery	**6**
Distributed Database: Architecture, Fragmentation and Allocation Transparency, Basic Concept of Distributed Database Design (through small use cases), Sharding and Replication, CAP Theorem.	**5**
No SQL Databases: Features of various types of No-SQL databases, Brief Concept on Key-value database, Document Store, Column Family Stores and Graph databases.	**5**

Books:

1. Avi Silberschatz, Hank Korth, and S. Sudarshan, "Database System Concepts", 6 th Ed. McGraw Hill, 2010.
2. Ramez Elmasri, B.Navathe, "Fundamentals of Database Systems", 7th edition, Addison Wesley,2014
3. Sadalage, P., Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012
4. Database System Concepts, Abraham Silberschatz, Henry Korth, and S. Sudarshan, McGraw-Hill.

CSMC 202: Advanced Operating System

MODULES	HOURS
Introduction: Distributed system, distribution transparency, loosely couple versus tightly coupled system architecture, distributed shared memory.	**3**
Message Passing: Inter-process communication, group communication, broadcasting algorithms, case study with MPI.	**3**
Clock synchronization: Event ordering, event precedence, Logical Clock model, Vector Clock.	**3**
State Recording: Naïve State Recording algorithm, Chandy-Lamport's state recording algorithm.	**3**
Mutual exclusion in distributed environment: Ricart-Agrawala Algorithm, Token based ME algorithm for Ring topology, Raymond's Algorithm	**6**
Deadlock detection for Distributed Systems: Mitchell-Merritt Algorithm, Ho-Ramamurthy Algorithms, Termination Detection algorithm – weight-throwing algorithm, diffusion computation algorithm.	**4**
Process Management: Process migration, Pre-emptive and non-preemptive process migration, Resource migration, Resource-Process binding, Resource-Machine binding, Challenges and limitations for creating global references for resources	**6**
Remote Procedure Call: RPC Model, stub generation, server management, parameter passing, call semantics, communication protocols, Client-Server binding, exception handling, security, optimization, Case study on SUN RPC.	**8**
Distributed File Systems: System wide deployment of DFS, Client-Server model for DFS, Indexed Block model for DFS, Case study on Hadoop File System, Naming in distributed systems, directory services, DNS.	**4**

Books:

1. Mukesh Singhal, Niranjan Shivaratri: Advanced Concepts in Operating Systems, Tata McGraw-Hill Education, 2001.
2. S. Tanenbaum: Distributed Operating Systems, Prentice Hall of India, New Delhi, 1996.
3. G. F. Colouris, J. Dollimore and T. Kindberg: Distributed Systems: Concepts and Design, 2nd ed., Addison-Wesley, Reading, Mass., 1994.
4. S. J. Mullender (Ed.): Distributed Systems: An Advanced Course, 2nd ed., Addison-Wesley, Reading, Mass., 1993.
5. P. K. Sinha: Distributed Operating Systems, IEEE Press, Los Alamos, California, 1997.

Automata Theory and Compiler Design

I. Automata Theory

Introduction: **3**

Definition of a Finite Automaton, Non-deterministic Finite state Automaton (NDFA), Deterministic Finite state Automaton (DFA), NDFA to DFA conversion, Minimized Equivalent Machine, State Minimization Algorithm – Row elimination method, Implication Table Method, Basics of regular expression.

Formal languages and grammar: **3**

Introduction to Formal Grammar and Language, Chomsky's Classification of Grammar – Type 0, Type-1 or Context Sensitive, Type-2 or Context Free and Type-3 or Regular Grammar, CNF, GNF. Illustration of each of these classes with example, Derivation tree, Parse Tree, Syntax Tree, Ambiguous and Unambiguous Grammar.

Regular expression to Finite Automata conversion, FA to Regular Grammar and Regular Grammar to FA conversion

Push-down automata (PDA): **3**

Definition, PDA and CFL: design and conversion, Acceptance of Strings.

Turing Machine: **4**

Introduction, Turing Machine Model, Computable languages and function

II. Compiler Design

Introduction to Compiling **2**

Introduction, Analysis-synthesis model, Phases of the compiler.

Lexical analysis **2**

Role of lexical analyser, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, Design of a lexical analyser generator (Lex).

Syntax analysis **9**

The role of a parser, Context free grammars, Writing a 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 directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, and Bottom-up evaluation of inherited attributes.

Run time environment: **2**

Parameter passing, symbol table, dynamic storage allocation techniques

Intermediate code generation: **4**

Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Code generation and optimization: **8**

Issues in the design of code generator, a simple code generator, Register allocation and assignment, Introduction to code optimization, Basic blocks & flow graphs, Transformation of basic blocks, DAG representation of basic blocks, the principle sources of optimization, Loops in flow graph, Peephole optimization.

Cryptography & Network Security

MODULES	HOURS
Introduction: Classification of Possible attacks, Traditional Encryption Techniques: Affine, Play Fair, Hill cipher and Vernam cipher with subsequent strength analysis. Symmetric key & Asymmetric key cryptography, Block & Stream Cipher, Stream Cipher generation technique LFSR.	**4**
Symmetric Key Cryptography: Modular Arithmetic, Extended Euclidean Algorithm, Group, Ring and Finite Field, Polynomial Arithmetic, Shannon's Theorem, Feistel structure, DES and AES algorithm with strength analysis, Diffie Hellman Key Exchange Problem & Man-in-the Middle attack, 2 DES and 3 DES. Algorithmic Modes.	**9**
Asymmetric Key Cryptography: Fermat's and Euler's Theorem, Primality Testing, Discrete Logarithm, The Chinese Remainder Problem, RSA, Elgamal, Eliptic Curve algorithms with necessary mathematical analysis,	**9**
Message Integrity: Hash function, Hash function criteria, Evaluating the security of Cryptographic hash functions, MAC, Brief idea on MD5, SHA-1, H-MAC.	**3**
Authentication techniques: Password Based and Challenge Response based authentications, Role of KDC in Key-exchange and Authentication, Needham Schroder algorithm, Kerberos	**3**
Security layers in Network Protocol Stack: IP Sec, AH & ESP, Transport & Tunnel Modes, Security Association, IKE protocol, Secure Socket Layer, Security protocols used in Application layer like PGP, SHTTP etc.	**6**
Digital Signature: Concepts and the techniques through RSA, Basics of Steganography.	**4**
Network Defense tools: Firewalls, Intrusion Detection, Filtering, Security in Mobile Platforms: Threats in mobile applications, analyzer for mobile apps to discover security vulnerabilities.	**2**

IT-502: Digital Signal Processing [40 lectures]:

Introduction to Discrete–time Signals and Systems [10 lectures]

- Classification of Discrete time signals and sequences --- Linear time-invariant (LTI) systems, (BIBO) stability, and causality; linear convolution in time domain; graphical approach [5 lectures]
- The concept of z-Transforms --- Region of convergence; properties; inverse z-transform; realization of digital filter structures (direct forms I and II, transposed form, cascaded form, parallel form) [5 lectures]

Discrete-time Signals in Transform Domain [12 lectures]

- Discrete Fourier Series (DFS) and Discrete-time Fourier Transforms (DTFT) [4 lectures]
- Discrete Fourier Transform (DFT) --- Properties of DFT, linear convolution using DFT; circular convolution; fast Fourier transforms (FFT); radix-2 decimation in time and decimation in frequency; FFT algorithms; inverse FFT [8 lectures]

Digital Filters [18 lectures]

- Infinite Impulse-response (IIR) filters ---analog filter approximations (Butterworth and Chebyshev); impulse invariant transformation; bilinear transformation; design of IIR filters from analog filters [8 lectures]
- Finite Impulse-response (FIR) Filters ---Characteristics of FIR filters; frequency response; design of FIR filters using window techniques; comparison of IIR and FIR filters [8 lectures]
- Multi-rate Processing --- Decimation; interpolation; sampling-rate conversion; implementation of sampling rate conversion [2 lectures

Reference Books:

1. **Sanjit K. Mitra**, Digital Signal Processing, 2nd Edition, TATA McGraw Hill
2. **John G. Proakis and Dimitris G. Manolakis**, Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education/PHI, 2007
3. **Alan V. Oppenheim and Ronald W. Schafer**, Digital Signal Processing, PHI Ed., 2006
4. **Andreas Antoniou**, Digital Signal Processing, TATA McGraw Hill , 2006
5. **MH Hayes**, Digital Signal Processing, Schaum's Outlines, TATA Mc-Graw Hill, 2007

CBCC offered by Department of Electronic Science

Electronics

Module – 1: Introduction to Semiconductor Physics & Device Fabrication Technology
Introduction, concept of energy bands, Fermi level, intrinsic and extrinsic semiconductors, P-type and N-type semiconductors, energy band diagram, effective mass, carrier transport, mobility, drift and diffusion, carrier recombination, introduction to device fabrication technology.

Module – 2: Junction Diodes:
Formation of P-N junction, energy band diagram, depletion region, forward and reverse biased P-N junction diode, I-V characteristics, breakdown mechanisms, Zener breakdown, Avalanche breakdown, Zener diode and its characteristics, junction capacitance and Varactor diode, diode rectifier circuits and Zener voltage regulators.

Module – 3: Bipolar Junction Transistors:
PNP and NPN transistors, energy band diagram, working principle of transistor, cut-off, active and saturation, current components in active mode, transistor characteristics, CE, CB, CC configurations, transistor as an amplifier and a switch, biasing and bias stability, CE h-parameter model, analyses of amplifiers using h-parameter model.

Module – 4: Field Effect Transistors:
JFET, construction, working principle, I-V characteristics, small signal equivalent circuit of JFET, MOS devices, concept of depletion and inversion in MOS capacitor, MOSFET, construction, working principle, characteristics, depletion and enhancement type, introduction to CMOS.

Module – 5: Analog Circuits:
Concept of positive and negative feedback, feedback topologies, effects of negative feedback (qualitative), Barkhausen criteria, condition of oscillation, operational amplifier and its characteristics, applications of Op-Amp.

Module – 6: Digital Electronics:
Introduction to number systems, Boolean algebra, logic gates, k-map minimization, half and full adder, subtractor, parity checker, comparator, multiplexer, demultiplexer, encoder, decoder, SR, JK, D and T flip-flops, shift registers, counters.

Paper code- CSMC304 **Paper Name- Artificial Intelligence**		**Marks: 100**
Module	**Topics**	**Lectures**
I. Introduction to AI	Turing Test and Rational Agent approaches to AI; Distributed AI; Applications	2
II. Introduction to state Space search	Agents & environment, nature of environment, structure of agents, goal-based agents, utility-basedagents, learning agents. Problems, Problem Space & search: Defining the problem as state space search, Water Jug Problem; production system, problem characteristics, issues in the design of search programs. Solving problems by searching: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies	6
III. Heuristic search	Greedy best-first search, A* search, AO* algorithm; memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.	6
IV. Knowledge representation and Reasoning	Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation Predicate logic: Representing simple fact in logic, Modus ponen and tollen; Common Sense; representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction; Representing knowledge using rules: Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.	8
V. Soft Computing Approaches	Overview, Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster- Shafer theory, Fuzzy vs Crisp; Fuzzy sets & fuzzy logic. Rough set; Genetic Algorithm: Multi-objective optimization, Pareto optimal front	6
VI. Neural Network Learning	Biologically Inspired model, Various activation functions; Perceptron; Backpropagation: Gradient Decent; MAXNET; ADALINE, MADALINE, SOM, ART	8
VII. Expert system	Definition; Features of an expert system; Organization; Characteristics; Prospector; Knowledge Representation in expert systems; Expert system tools Representing and using domain knowledge; expert system shells, knowledge acquisition	4

Books:

1. Dan.W. Patterson, Introduction to AI and Expert Systems – PHI, 2007
2. Stuart Russel and Peter Norvig, 'Artificial Intelligence - A Modern Approach', Second Edition, Pearson Education, 2003 / PHI.
3. George F. Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', Fourth Edition, Pearson Education, 2002.
4. Elain Rich and Kevin Knight, 'Artificial Intelligence', Second Edition Tata McGraw Hill, 1995.
5. Simon Haykin, "Neural Networks and Learning Machines", Prentice Hall, 2009
6. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice-Hall (1995).

Paper code- CSME301 **Paper Name- Image Processing and Pattern Recognition**		**Marks: 100**
Module	**Topics**	**Hours**
Module-1: **Image Fundamentals**	Analog and digital images, image sensing and acquisition: Image formation, Sampling and quantization, Color space: Color (RGB, CMYK, HSI) vs gray level images, Matrix representation and intensity modification of digital images, Pixel adjacency and distance measure, Arithmetic, logical and set operations, Image file formats, Fundamental steps in DIP, Applications and state of the art in DIP.	6
Module-2: **Transformation and Filtering**	Point processing: Identity, image negatives, log transform, power law, contrast stretching, histogram equalization and specification. Spatial filtering: Linear filters: max, min, mean, median; order statistics filters. Frequency based transforms: Low and high pass filter, DFT Image restoration concept: Noise models, Image denoising and deblurring	10
Module-3: **Image segmentation**	Segmentation techniques, Threshold based segmentation, Importance of derivative and gradients in edge detection, Masks: Roberts, Prewitt, Sobel; Canny edge detection, Region growing and Split-Merge algorithms, Clustering based techniques, basics of Hough transform.	9
Module-4: **Image Compression**	Compression basics: Lossless, lossy, compression ratio, image compression models, evaluation criteria of a compression scheme, compression techniques: Huffman encoding, Run length, Arithmetic encoding.	5
Module-5: **Pattern recognition**	Introduction and applications. Feature extraction and reductions: Histogram of Gradient (HoG), Principal Component Analysis (PCA). Learning: Supervised and unsupervised; Clustering and Classification techniques: K-Nearest Neighbor Classifier, Support Vector Machine, K-means algorithm, Density-based Clustering.	10

Textbooks:

1. Digital Image Processing by Rafael C. Gonzalez, Richard E. Woods; Pearson; 4th edition (2017)
2. Image Processing: Principles and Applications by by Tinku Acharya, Ajoy K.Ray; Wiley-Interscience; 1st ed. (2005)
3. Digital Image Processing by William K. Pratt; John Wiley & Sons; 4th Edition (2007)
4. Digital image processing with MATLAB and LabView, Vipula Singh, Elsevier, 2013.
5. Pattern Classification by Richard O. Duda, David G. Stork, Peter E.Hart, Wiley; Second edition (2007)
6. Pattern Recognition by Sergios Theodoridis and Konstantinos Koutroumbas, Academic Press, 2008.
7. Pattern Recognition and Machine Learning by Christopher M. Bishop and Nasser M. Nasrabadi., New York: Springer, 2006.
8. Pattern recognition principles, Tou and Gonzalez, Addison Wesley, 1974.