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.

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-based agents, 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).

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.