M. Phil. Computer Science Elective 1

Subject Reference no:**CSC621,** Subject Title: **Advanced Image Processing,** No of Credits 4 Theory, 2 Seminar, 2 Tutorial Assignment/Sectionals (Internal) 20%, Total Contact Hrs/Week:4 Theory, 8 Practical External (Semester Exam) 80%

Objective: At the end of the course, student can be able to write a system to do perception ofpictorial data.

UNIT I:

Introduction: What Is Digital Image Processing? The Origins of Digital Image Processing, Examplesof Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing,Components of an Image Processing System.**Digital Image Fundamentals:** Elements of VisualPerception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Samplingand Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations, **ImageEnhancement in the Spatial Domain:**Background, Some Basic Gray Level Transformations,Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering,Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods,

UNIT II:

Image Enhancement in the Frequency Domain: Background, Introduction to the FourierTransform and the Frequency Domain, Smoothing Frequency-Domain Filters, Sharpening FrequencyDomain Filters, Homomorphic Filtering, Implementation, **Image Restoration:**A Model of the ImageDegradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-SpatialFiltering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-InvariantDegradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error(Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, GeometricTransformations, **Color Image Processing:**Color Fundamentals, Color Models, Pseudocolor ImageProcessing, Basics of Full-Color Image Processing, Color Transformations, Smoothing andSharpening, Color Segmentation, Noise in Color Images, Color Image Compression,

UNIT III:

Wavelets and Multiresolution Processing: Background, Multiresolution Expansions, Wavelet Transforms in One Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions, Wavelet Packets **Image Compression:** Fundamentals, Image Compression Models, Elements ofInformation Theory, Error-Free Compression, Lossy Compression, Image Compression Standards **Morphological Image Processing:** Preliminaries, Dilation and Erosion, Opening and Closing, TheHit-or-Miss Transformation, Some Basic Morphological Algorithms, Extensions to Gray-Scale Images,**Image Segmentation:**Detection of Discontinuities, Edge Linking and Boundary Detection,Thresholding, Region-Based Segmentation, Segmentation by Morphological Watersheds, The Use ofMotion in Segmentation,

UNIT IV:

Representation and Description: Representation, Boundary Descriptors, Regional Descriptors, Useof Principal Components for Description, Relational Descriptors, **Object Recognition:**Patterns andPattern Classes, Recognition Based on Decision-Theoretic

Methods, Structural Methods **3D vision, geometry:** 3D vision tasks, Marr's theory, Other vision paradigms: Active and purposive vision,Basics of projective geometry, Points and hyperplanes in projective space, Homography, Estimating hornography from point correspondences, A single perspective camera, Camera model, Projectionand back-projection in homogeneous coordinates, Camera calibration from a known scene, Scenereconstruction from multiple views, Triangulation, Projective reconstruction, Matching Constraints,Bundle adjustment, Upgrading the projective reconstruction, self-calibration, Two cameras, stereopsis, Epipolar geometry; fundamental matrix, Relative motion of the camera; essential matrix, Decomposing the fundamental matrix to camera matrices, Estimating the fundamental matrix frompoint correspondences, Rectified configuration of two cameras, Computing rectification, Threecameras and trifocal tensor, Stereo correspondence algorithms, Active acquisition of range images, 3D information from radiometric measurements, Shape from shading, Photometric stereo,

UNIT V:

Use of 3D vision: Shape from X, Shape from motion, Shape from texture, Other shape from Xtechniques, Full 3D objects, 3D objects, models, and related issues, Line labeling, Volumetric representation, direct measurements, Volumetric modeling strategies, Surface modeling strategies, Registering surface patches and their fusion to get a full 3D model, 3D model-based vision, Generalconsiderations, Goad's algorithm, Model-based recognition of curved objects from intensity images, Model-based recognition based on range images, 2D view-based representations of a 3D scene,Viewing space, Multi-view representations and aspect graphs, Geons as a 2D view-based structural representation, Visualizing 3D real-world scenes using stored collections of 2D views, 3D reconstruction from an unorganized set of 2D views—a case study, **Motion analysis:** Differential motion analysis methods, Optical flow, Optical flow computation, Global and local optical flowestimation, Combined local-global optical flow estimation, Optical flow in motion analysis, Analysisbased on correspondence of interest points, Detection of interest points, Correspondence of interestpoints, Detection of specific motion patterns, Video tracking, Background modeling, Kernel-basedtracking, Object path analysis, Motion models to aid tracking , Kalman filters , Particle filters

Books:

1. Rafael Gonzalez, Richard Woods Digital Image Processing:2/e, Pearson PrenticeHall,2004 ISBN-10: 0201180758 | ISBN-13: 9780201180756
2. Image Processing: Analysis and Machine Vision, Milan Sonka, Thomson Learning

References:

1. Machine Vision, Jain R C Kasturi R, McGrawHill
2. Anil Jain Fundamentals of Digital Image Processing:1/e Pearson Prentice Hall
3. Three Dimensional Computer Vision, Y Shirai, Springer Verlag
4. Computer And Robot Vision Vo I and II, Haralick R M And Shapiro L G, Addison Wesley
5. Computational Vision, Wechsler, Academic Press
6. Robot Vision, Horn B K P, Cambridge MIT press
7. Digital Image Processing & Computer Vision, Robert J Schalkoff, John Willey Publication
8. Computer Vision: A Modern Approach, Forsyth Ponce , Pearson Education