GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (COMMUNICATION SYSTEMS ENGG) (05)
ADVANCED IMAGE PROCESSING
SUBJECT CODE: 2710506
SEMESTER: I

Type of course: Major Elective - I

Prerequisite Higher Engineering Mathematics, Fundamental knowledge of signals and systems along with types, Mathematical representation of signals and system modeling in time as well as frequency domain. Fourier Transforms, Basic analysis and synthesis procedure

Rationale: PG Students of EC Engineering need to possess good understanding of the fundamentals and applications of Image Processing specially in image feature extraction, including basic image processing operations, Low-level feature extraction (including edge detection), Feature extraction by shape matching, Flexible shape extraction (snakes and other techniques), Object description, Introduction to texture description, segmentation and classification and 3-Dimage processing. They are expected to be able to design algorithms in MATLAB software running on PC,digital ,this includes both the analysis and synthesis

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2	4	70	30	20	10	20	0	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Basic image processing operations** Overview, Histograms, Point Operators Group operators, Other statistical Operators, Mathematical morphology	2	5
2	**Low- level feature extraction (including edge detection)** Overview, First-order edge detection operators , Second- order edge detection operators, Other edge detection operators, Comparison of edge detection operators , Phase Congruency, Localized feature extraction, Detecting image curvature ,Describing image motion	4	10
3	**Feature extraction by shape matching** Overview, Thresholding and subtraction, Template matching Hough transform (HT), Generalized Hough transform (GHT) Other extensions to the HT	4	12
4	**Flexible shape extraction (snakes and other techniques)** Overview, Deformable templates, Active contours (snakes), Shape skeletonization, Flexible shape models: active shape and active Appearance	4	13
5	**Object description** Overview, Boundary descriptions(Boundary and region, Chain codes, Fourier descriptors), Region descriptors(Basic region descriptors,	6	14

	Moments)		
6	**Introduction to texture description, segmentation and classification** Overview , What is texture, Texture description(Performance requirements, Structural approaches, Statistical approaches, Combination approaches), Classification(The k-nearest neighbor rule, Other classification approaches), Segmentation	7	16
7	**3D Image Acquisition** Volume imaging vs. sections, Basics of reconstruction, Algebraic reconstruction methods, Maximum entropy, Defects in reconstructed images, Imaging geometries, Three-dimensional tomography, High-resolution tomography	6	14
8	**3D Image Visualization** Sources of 3D data, Serial sections, Optical sectioning Sequential removal Stereo, 3D data sets, Slicing the data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Special display hardware, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D,Measurements on 3D images.	7	16

Reference Books:
1. Feature Extraction and Image Processing, Mark S. Nixon and Alberto S. Aguado, S econd Edition
2. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Third Edition, Pearson Education
3. Fundamentals of Digital Image Processing:Practical Approach with examples in MATLAB, Chris Solomon and Toby Breckon,Wiley-Blackwell.
4. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, Second Edition, Tata McGraw Hill Publication Digital Image Processing, S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill Publication
5. Digital Image Processing, S Sridhar, Oxford University Press
6. The Image Processing Handbook, Third Edition *by John C. Russ* CRC Press, CRC Press LLC ISBN: 0849325323 Pub Date: 07/01/98

Course Outcome:

A student who successfully completes this course should, at a minimum, should be able to:

1. Understanding of digital image processing fundamentals to enhance image and reduce noise from image.
2. Analyze and implement different image processing algorithms for 2-D and 3-D images.
3. Ability to write image processing programs in MATLAB.

List of Experiments:

1. Image Enhancement : Point Processing Techniques
2. Image Enhancement : Histogram Equalization
3. Image Enhancement : Low pass Filtering
4. Image Enhancement : Sharpening Filter
5. Image Enhancement : Erosion & Dilation of image
6. Image Segmentation : First order Edge Detection operators: Roberts, Prewitts, sobel operators, Canny operator
7. Image Segmentation : Second order Edge Detection operators: laplacian, Marr–Hildreth operator
8. Morphological Processing: Boundary Extraction
9. Morphological Processing: Object Identification

10. Feature Extraction: Texture filters
11. Segmentation: Split and Merge Algorithms

Open Ended Problems:

1. Write MATLAB code for the self-developed feature extraction algorithm

List of Software:
1. MATLAB
2. Scilab