

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ELECTRONICS & COMMUNICATION (WIRELESS COMMUNICATION TECHNOLOGY) (44)

### DIGITAL IMAGE PROCESSING

**SUBJECT CODE: 2724411**

M. E. Semester – II

**Type of course:** Major Elective-II

**Prerequisite:** Students should have an understanding of basic Digital Image Processing fundamentals and programming skills.

**Rationale:** Students of ME in Signal Processing must require fundamental as well as advance concepts of Digital Image Processing. Students also need to apply the concepts for various kinds of Image Processing applications like image feature extraction, Object description, texture description etc. and able to develop efficient algorithms to fulfill it.

#### Teaching and Examination Scheme:

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

#### Content:

Sr. No.	Content	Total Hrs	% Weightage
<b>1</b>	<b>Basic image processing operations:</b> <ul style="list-style-type: none"> <li>• Overview</li> <li>• Histograms</li> <li>• Point operators</li> <li>• Group operations</li> <li>• Other statistical operators</li> <li>• Mathematical morphology</li> </ul>	<b>05</b>	15%
<b>2</b>	<b>Image Compression:</b> <ul style="list-style-type: none"> <li>• Fundamentals , Models</li> <li>• Basic compression methods: Huffman Coding- Arithmetic coding</li> <li>• Digital Image water marking</li> </ul>	<b>05</b>	10%
<b>3</b>	<b>Low-level feature extraction:</b> <ul style="list-style-type: none"> <li>• Overview, First order edge detection operators</li> <li>• Second order edge detection operators</li> <li>• Other edge detection operators</li> <li>• Comparison of edge detection operators</li> <li>• Phase congruency</li> <li>• Localized feature extraction,</li> <li>• Describing image motion</li> </ul>	<b>08</b>	20%
<b>4</b>	<b>Feature extraction by shape matching:</b> <ul style="list-style-type: none"> <li>• Overview</li> <li>• Thresholding and subtraction</li> <li>• Template matching</li> </ul>	<b>05</b>	15%

	<ul style="list-style-type: none"> <li>• Hough transform</li> </ul>		
5	<b>Flexible shape extraction:</b> <ul style="list-style-type: none"> <li>• Deformable templates</li> <li>• Active contours</li> <li>• Shape skeletonization</li> <li>• Flexible shape models</li> </ul>	05	10%
6	<b>Object Representation and Description:</b> <ul style="list-style-type: none"> <li>• Representation</li> <li>• Boundary descriptions</li> <li>• Region descriptors</li> <li>• Relational Descriptors</li> <li>• Texture description</li> </ul>	06	20%
7	<b>3D Image Processing:</b> <ul style="list-style-type: none"> <li>• 3D Image Acquisition: Volume imaging</li> <li>• Basics of reconstruction</li> <li>• Algebraic reconstruction methods</li> <li>• 3D Image Visualization: Sources of 3D data</li> <li>• Serial sections, Optical sectioning</li> <li>• Sequential removal</li> <li>• Stereo, 3D data sets, Slicing the data set</li> </ul>	05	10%
<b>Total</b>		<b>39</b>	

#### Reference Books:

1. Feature Extraction and Image Processing, Mark S. Nixon and Alberto S. Aguado, Second Edition
2. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Third Edition, Pearson Education
3. The Image Processing Handbook, Third Edition by John C. Russ CRC Press
4. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, Second Edition, Tata McGraw Hill Publication

#### Course Outcome:

Students who successfully complete this course should be able to –

1. Apply basic image processing operations and verify the result.
2. Describe types and models of image compression.
3. Explain the importance of segmentation and feature extraction in image processing.
4. Describe various methods to extract features.
5. Explain object representation and description.
6. Understand fundamentals of 3-D image processing.
7. Develop advance image processing algorithms.

#### List of Experiments:

##### EXP. NO.

##### NAME OF THE EXPERIMENT

1. Image Enhancement: Point Processing Techniques, Histogram Equalization.
2. Image Enhancement: Estimate noise parameter of noisy image and design filter to remove it.
3. Image Enhancement: Remove motion blur.
4. Image Compression: Lossy and Lossless, measure compression ratio.

5. Perform Digital Image water marking.
6. Morphological Operations: Gray image Erosion & Dilation.
7. Morphological Processing: Boundary Extraction, Object Identification.
8. Detection of motion by differencing.
9. Image Segmentation: First order Edge Detection operators: Roberts, Prewitts, sobel operators, Canny operator.
10. Image Segmentation: Second order Edge Detection operators: Laplacian, Marr–Hildreth operator.
11. Image Segmentation: Hough transform for lines and circles.
12. Segmentation: Split and Merge Algorithms.
13. Feature Extraction: Texture filters.

**Open Ended Problems:**

1. Write C code to read digital image.
2. Write C code to rotate the image by  $45^{\circ}$  angles.
3. Write C code to find histogram of the image.
4. Write C code to detect edges of the image.
5. Write C code to detect line using Hough transform.
6. Write C code for template matching.

**Major Equipments:**

- i. Computer System.

**List of Software:**

- i. MATLAB
- ii. Scilab

**Learning website:**

[www.nptel.ac.in](http://www.nptel.ac.in)

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website