

# GUJARAT TECHNOLOGICAL UNIVERSITY

## INSTRUMENTATION & CONTROL ENGINEERING (17)

### IMAGE PROCESSING

SUBJECT CODE: 2171712

B.E. 7<sup>th</sup> SEMESTER

**Type of course:** Core Engineering

**Prerequisite:** Digital Signal Processing, Transform techniques.

**Rationale:** Image processing becomes a very important aspect in various industries ranging from process industry to medical field. This course will help to understand the fundamentals of image processing. Student will also learn to apply various processes on images for image understanding. The course also touches the design aspects and realization of image processing applications.

**Teaching and Examination Scheme:**

TeachingScheme			Credits C	Examination Marks					Total Marks	
L	T	P		TheoryMarks		PracticalMarks				
			ESE (E)	PA(M) PA ALA	ESE (V) ESE OEP		PA (I)			
4	0	2	6	70	20	10	20	10	20	150

**Content:**

S. N.	Content	Total Hrs	Weightage %
1	<b>Introduction and Digital Image Fundamentals</b> Digital Image Fundamentals, Human visual system, Image as a 2D data, Image representation – Gray scale and Color images, image sampling and quantization	03	06
2	<b>Image enhancement in Spatial domain:</b> Basic gray level Transformations, Histogram Processing Techniques, Spatial Filtering, Low pass filtering, High pass filtering	08	15
3	<b>Filtering in the Frequency Domain:</b> Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering	05	10
4	<b>Image Restoration and Reconstruction:</b> Noise Models, Noise Reduction, Inverse Filtering, MMSE (Wiener) Filtering	05	10
5	<b>Color Image Processing:</b> Color Fundamentals, Color Models, Pseudo color image processing	03	06
6	<b>Image Compression:</b> Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, LZW coding, JPEG Compression standard	04	08
7	<b>Morphological Image Processing:</b> Erosion, dilation, opening, closing, Basic Morphological Algorithms:	04	08

	hole filling, connected components, thinning, skeletons		
8	<b>Image Segmentation:</b> point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection, Hough transform	08	15
9	<b>Object Recognition and Case studies</b> Object Recognition- patterns and pattern classes, recognition based on decision – theoretic methods, structural methods, case studies – image analysis Application of Image processing in process industries	12	22

**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	14	21	14	14	0

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Text Books**

1. Gonzalez & Woods, —Digital Image Processing||, 3rd ed., Pearson education, 2008
2. Jain Anil K., —Fundamentals Digital Image Processing||, Prentice Hall India, 2010

**Reference Books:**

1. Milan Sonka, Vaclav Hlavav, Roger Boyle, —Image Processing, Analysis and Machine Vision||, 2nd ed., Thomson Learning, 2001
2. Rangaraj M. Rangayyan, —Biomedical Image Analysis||, CRC Press, 2005
3. Pratt W.K., —Digital Image Processing||, 3rd ed., John Wiley & Sons, 2007
4. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods.  
Publisher: Pearson Education

**Course Outcome:**

After learning the course the students should be able to:

- CO1 apply knowledge of mathematics for image understanding and analysis.
- CO2 design and analysis of techniques / processes for image understanding.
- CO3 design, realize and troubleshoot various algorithms for image processing case studies.
- CO4 select the appropriate hardware and software tools (Contemporary) for image analysis.

**List of Experiments:**

1. Introduction to Image Processing Toolbox

2. Read an 8 bit image and then apply different image enhancement techniques:
  - (a) Brightness improvement
  - (b) Brightness reduction
  - (c) Thresholding
  - (d) Negative of an image
  - (e) Log transformation
  - (f) Power Law transformation.
3. Implement different interpolation techniques using MATLAB/ Scilab
4. Read an image, plot its histogram then do histogram equalization. Comment about the result.
5. (a) Implement Gray level slicing (intensity level slicing) in to read cameraman image.
  - (b) Read an 8 bit image and to see the effect of each bit on the image.
  - (c) Read an image and to extract 8 different planes i.e. 'bit plane slicing.'
6. Implement various Smoothing spatial filter.
7. Read an image and apply (1) Gaussian 3x3 mask for blurring (2) High pass filter mask with different masks (3) Laplacian operator with centre value positive and negative (4) High boost filtering.
8. Write a program to implement various low pass filters and high pass filter in frequency domain.
9. Write a program for erosion and dilation, opening & closing using inbuilt and without inbuilt function.
10. Implement and study the effect of Different Mask (Sobel, Prewitt and Roberts)
11. Implement various noise models and their Histogram
12. Implement inverse filter and wiener filter over image and comment on them
13. Implement Image compression using DCT Transform

**Design based Problems (DP)/Open Ended Problem:**

Find out the application of image processing in automation field. Do the simulation of the application that you have identified of image processing.

**Major Equipment: Computers, simulation software – MATLAB/ SciLab, etc.**

**List of Open Source Software/learning website:**

<http://nptel.ac.in/video.php>

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate

chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.