



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3170308

Semester – VII

Subject Name: Biomedical Image Processing

Type of course: Professional Core Course

Prerequisite: Biomedical Signals & Systems, Fourier transform.

Rationale: The purpose of this course is to learn the fundamentals and various techniques of biomedical image processing and to develop the algorithms for image analysis and diagnosis in medical imaging.

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)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Fundamentals of Digital Image Image formation, visual perception, CCD & CMOS Image sensor, Image sampling: Two dimensional Sampling theory, Hexagonal Sampling and Non Uniform Sampling, Optimal sampling, Image quantization, Non uniform Quantization, Image formats. Types of pixel Operations, Types of neighborhoods, adjacency, connectivity, boundaries, regions, Color models.	07
2	Image Enhancement in Spatial and Frequency domain Basic gray level transformations, histogram processing, Smoothing operations, Edge Detection-derivative based operation, filtering in frequency domain, 2D-DFT, Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering.	10
3	Morphological Image Processing & Image Compression Dilation and Erosion, Opening and Closing, Hit-or-Miss transformation, Boundary Extraction, Region filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening, Skeletons, Pruning.	10
4	Image Segmentation Detection of discontinuities, Point-line- edge detection, Linear and Circular Hough Transform, Basic Global and Adaptive Thresholding, Region Based segmentation, K-Means Clustering.	09
5	Image Compression & Description:	09

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Fundamentals of Image compression models, Lossless compression: variable length coding, LZW coding, Arithmetic coding, Lossy compression: Wavelet and DCT coding, Types of Image features, Chain code, Image Moments.	
Total	45

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15%	35%	30%	15%	5%	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.

Reference Books:

1. Digital Image Processing, Gonzalez and Woods- Pearson Education
2. Digital Image Processing, S. Sridhar – Oxford University Press.
3. Fundamentals of Digital Image Processing, A.K. Jain .P.H.I.
4. Digital Image Processing, William Pratt- John Wiley.
5. Feature Extraction and Image Processing, Mark S. Nixon and Alberto S. Aguado.
6. Digital Image Processing and Analysis, Chanda Majumder- Printice Hall India.
7. Medical image processing, Geoff Dougherty editor, springer.
8. Image processing, John G. Webster.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand image fundamentals and acquisition techniques.	15%
CO-2	Analyze images in the frequency domain using various transforms and perform enhancement	20%
CO-3	Evaluate and Understand the techniques for morphological operations	25%
CO-4	Evaluate methodologies for Image segmentation techniques	20%
CO-5	Understand Image Compression and Representation models	20%



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Suggested List of Experiments:

1. To implement basic operations of image processing in MATLAB.
2. To perform Mathematical and Logical Operations on Medical Images.
3. To implement Basic Image gray level transformations for medical images in spatial domain in MATLAB.
4. To implement piece-wise Linear Transformations functions for medical images in MATLAB.
5. To implement Image histogram processing and analyze it for medical images in MATLAB.
6. To implement Image enhancement of medical images by using spatial filtering in MATLAB.
7. To implement Image enhancement of medical images in frequency domain in MATLAB.
8. To perform Morphological Operations on Image
9. To implement Image segmentation using thresholding and edge detection technique in MATLAB.
10. To implement Image segmentation by using K-means clustering in MATLAB.
11. To implement DCT Compression technique on medical image in MATLAB.
12. To implement Image compressions and feature extraction by using wavelet transform in MATLAB.

Major Equipment: Image Acquisition System

List of Open Source Software/learning website: SCILAB, OpenCV

NPTEL Course on Digital Image Processing - <https://nptel.ac.in/courses/117/105/117105079/>

<https://nptel.ac.in/courses/106/105/106105032/>