

**SGGS Institute of Engineering and Technology, Vishnupuri, Nanded**  
**Department of Electronics and Telecommunication Engineering**

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**Ph. D. Course work for candidates registered in 09-2010 and 2010-2011 for  
 Paper-3 and Paper-4**

Sr. No.	Registration No.	Name of the Candidate	Name of the Guide(s)	Subject of Ph. D.	Paper-3	Paper-4	Year of Registration
1.	2009PEXTC001	A.M. Bagade	Dr. S. N. Talbar	Computer Science & Engg.	3a. Image Processing	3b_1. Special Topics in Image Processing	2009
2.	2009PEXTC002	Ms. Rajankar S.O.	Dr. S. N. Talbar	Electronics and Telecommunication	3a. Image Processing	3b_2. Data Compression	2009
3.	2010PEXTC001	Rajesh P. Borole	Dr. S V. Bonde	Electronics and Telecommunication	Advanced Digital Signal Processing	Digital Image Processing	2010
4.	2010PEXTC002	Nishikant Surwade	Dr. S V. Bonde	Electronics and Telecommunication	Advanced Digital Signal Processing	Digital Image Processing	2010
5.	2010PEXTC003	Nilesh P. Bhosale	Dr. M.B.Kakare	Electronics and Telecommunication	Image Processing	Special Topics in Image Processing and Pattern Recognition	2010
6.	2010PEXTC004	Kailash Sharma	Dr. R.R. Manthalkar	Electronics and Telecommunication	3a. Image Processing	Pattern Recognition	2010
7.	2010PEXTC005	Swati Deshmukh	Dr. R.R. Manthalkar	Electronics and Telecommunication	3a. Image Processing	Pattern Recognition	2010

The syllabus for paper-3 and paper-4 mentioned in the above table in front of candidate name is given below:

## **Advanced Digital Signal Processing**

Fundamentals of DSP background and review of discrete time random signals.

Discrete Fourier Transform: representation, properties and computation of the DFT (FFT), decimation in time and frequency.

Filter design techniques: Design of IIR filters, Impulse invariance, bilinear transformation, Design of FIR filters by windowing and frequency sampling

Quantization effects: Effect of round off noise in digital filter, zero input limit cycles in fixed point realization of IIR digital filters. Effects of finite register length in DFT computations.

Multirate digital signal processing: Fundamentals of Multirate systems, Basic multirate operations, Decimation, interpolation, filter design and implementation of sampling rate conversion, polyphase filter structures, time variant filter, structures, multistage implementation of sampling rate conversion of BP signals, sampling rate conversion by an arbitrary factor, interconnection of building blocks, polyphase representation, multistage implementations.

Wavelet Transform: Introduction to wavelets, wavelets and wavelet expansion systems, discrete wavelet transform, multiresolution formulation of wavelet systems, Haar Wavelet and other wavelet representations, scaling function, wavelet functions, Parseval's theorem

### **REFERENCES:**

1. S. K. Mitra, Digital signal processing: A computational approach, TMH
2. Johnny Johnson, Introduction to digital signal processing, PHI.
3. Oppenheim, Schafer, and Buck, Discrete-time signal processing, Pearson Education LPE
4. P. P. Vaidyanathan, Multirate filters and Filter banks, PH International, Englewood Cliffs
5. Rabiner and Schafer, Multirate signal Processing, PH International, Englewood Cliffs
6. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

## **Digital Image Processing**

Introduction: Digital image representation, fundamental steps in image processing, elements of digital image processing systems, hardware for image processing system, Frame Grabber, Characteristics of image digitizer, Types of digitizer, Image digitizing components, Electronic image tube cameras, solid state cameras, scanners.

Digital image fundamentals: Elements of visual perception, a simple image model sampling and quantization some basic relationship between pixels, image geometry,

Basic transformations, perspective transformation, camera model and calibration, stereo imaging.

Image transforms: 2-D Fourier transform, Fast Fourier transform, Other separable transforms, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, wavelet Transform, Haar function, Gabor Transform, Hotelling transforms.

Image enhancement: Enhancement by point processing, spatial filtering, enhancement in the frequency domain, Color image processing.

Image restoration: Degradation model, diagonalization of circulate and block-circulate matrices, algebraic approach to restoration, inverse filtering, least mean square (wiener) filter, constrained least squared restoration, invractive restoration.

Image compression: Redundancies, image compression models, elements of information theory, error-free compression variable length coding, bit plane coding, lossless predictive coding, lossy compression, predictive coding, transform coding, video compression, image compression standards- JPEG, MPEG.

Image Analysis: Segmentation, detection of discontinuities, edge linking and boundary detection, thresholding, region -oriented segmentation, Representation and description: Representation schemes, descriptors, regional descriptors, pattern and pattern classes, Classifiers.

#### **REFERENCES:**

1. R. C. Gonzalez and R. E. Woods, Digital image processing, Addison-Wesley Publishing House.
2. A. K. Jain, Fundamentals of digital image processing, Prince-Hall India.
3. K. R. Castleman, Digital Image Processing, Prince-Hall International.

### **Image Processing**

Digital Image fundamentals: Representation, Elements of visual perception, Simple image formation model, Image sampling and quantization, Basic relationships between pixels, Imaging geometry.

Image Enhancement: Basic gray level transformations, histogram processing, Spatial filtering, Frequency domain filters, homomorphic filtering., Color Image Processing: Color fundamentals, color models, pseudo-color image processing, basics of full color image processing, color transformations, smoothing and shaping, color segmentation, noise in color images.

Image transforms: 2D-DFT, FFT and its properties, KLT, Hadamard/Walsh, DCT, etc.

Image Compression: Redundancy, Image compression models, Elements of information theory, Error free compression, lossy compression, Image compression standards: JPEG & MPEG, Transform based Compression, Vector Quantization.

Image Segmentation: Detection of discontinuities, edge linking and boundary detection, and thresholding, region based segmentation by morphological watersheds, the use of motion in segmentation.

**Books:**

1. R.C. Gonzalez, R.E.Woods, "Digital Image Processing", Pearson Education, 2<sup>nd</sup> Ed., 2002.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India.
3. T. Acharya & A.K. Ray, "Image Processing: Principles and Applications" Wiley Inter-science, 2005.

**Special Topics in Image Processing and Pattern Recognition**

Principle Component Analysis, Independent Component Analysis, Application based on PCA, ICA, AdaBoost Algorithm, Intro to Wavelets Transform: Image pyramids, Haar transform.

Representation Schemes: chain codes, Signatures, Boundary descriptors, Regional descriptors, Texture Analysis: Texel, Co-occurrence Matrix, Texture Gradient, Texture Segmentation, Image Mining and CBIR, Reduction of Semantic Gap in low level and High Level Features.

Pattern Recognition: Introduction to statistical decision theory, probability-joint distributions and densities, moments of random variables, minimum risk estimators, statistical decision making, Bayes' theorem, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving one-out technique, characteristic curves

Nonparametric decision making, histograms, kernels and window functions, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminant functions, minimum squared error discriminant functions, choosing a decision making technique

Clustering, hierarchical and partitional clustering

Books:

1. Acharya and A,K, Ray, "Image Processing: Principles and Appls." Wiley Inter-science, 2005.
2. Earl Gose, R Johnonbaugh, and Steve Jost, "Pattern Recognition" PHI, 2008.
3. Stark, "Sparse Image & Signal Processing", Springer, 2010
4. G. Wolberg, Digital Image Warping, IEEE Computer SocietyPress, Los Alamitos, Calif., 1990.
5. Yung-Yu Chuang , Image warping/morphing, Digital Visual Effects, Spring 2007

**(3a): Image Processing**

Digital Image fundamentals: Representation, Elements of visual perception, Simple image formation model, Image sampling and quantization, Basic relationships between pixels, Imaging geometry.

Image Enhancement: Basic gray level transformations, histogram processing, Spatial filtering, Frequency domain filters, homomorphic filtering., Color Image Processing: Color fundamentals, color models, pseudo-color image processing, basics of full color image

processing, color transformations, smoothing and shaping, color segmentation, noise in color images.

Image transforms: 2D-DFT, FFT and its properties, KLT, Hadamard/Walsh, DCT, etc.

Image Compression: Redundancy, Image compression models, Elements of information theory, Error free compression, lossy compression, Image compression standards: JPEG & MPEG, Transform based Compression, Vector Quantization.

Image Segmentation: Detection of discontinuities, edge linking and boundary detection, and thresholding, region based segmentation by morphological watersheds, the use of motion in segmentation.

**Books:**

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2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India.
3. T. Acharya & A.K. Ray, “Image Processing: Principles and Applications” Wiley Inter-science, 2005.

**(3b\_1): Special Topics in Image Processing:**

Principle Component Analysis, Independent Component Analysis, Application based on PCA, ICA,

Intro to Wavelets Transform: Image pyramids, Haar transform.

Morphology: Dilation, Erosion, opening and closing, Some Basic morphological Algorithms and its extension to gray-scale images, Morphological component Analysis.

Image Warping Techniques: Feature based Image Warping, Mesh Warping; Thin Plate Spline(TPS) based image warping.

Computer Animation, Shape Transformation Metamorphosis, Role of morphing in image security, Mathematics behind field morphing, Comparison between stegenography and image morphing

Representation Schemes: chain codes, Signatures, Boundary descriptors, Regional descriptors, Texture Analysis: Texel, Co-occurrence Matrix, Texture Gradient, Texture Segmentation, Image Mining and CBIR.

**Books:**

1. Acharya and A,K. Ray, “Image Processing: Principles and Appls.” Wiley Inter-science, 2005.
2. Stark, “Sparse Image & Signal Processing”, Springer, 2010
3. G. Wolberg, Digital Image Warping, IEEE Computer SocietyPress, Los Alamitos, Calif., 1990.
4. Yung-Yu Chuang , Image warping/morphing, Digital Visual Effects, Spring 2007

### **(3b\_2): Data Compression:**

Entropy coding: Huffmann coding, RLE, Arithmetic, Predictive coding, Dictionary Methods: LZ77, LZSS, File Differencing, LZ78, LZW, LZJ etc

Image Compression: Transform coding-DCT, JPEG, JPEG\_LS, Progressive Image Compression, Wavelet based approaches to image compression. Vector Math for Transforms, Subbands, and Wavelets, Matrices and Vectors, Eigenvectors Coding, Subband Coding-Intro and Multirate Subband, Perfect Recon Filters, Wavelet decomposition methods, EZW, SPIHT algorithms, CREW, Laplacian Pyramid, JPEG2000.

Quantization: Scalar quantization, optimal & adaptive, vector quantization and its types, Block Truncation Coding.

Digital Video: Video compression, MPEG, MPEG-4, H.261

Audio Compression: Digital Audio, Human Auditory System, ADPCM Audio Compression, MLP Audio, Speech Compression, MPEG-1 Audio Layers

Biomedical Signal and Image compression: ECG/EMG data compression, Biomedical Imaging Modalities, X-Ray Imaging, and Compression

Books:

1. Khalid Sayood, "Introduction to Data Compression", 2<sup>nd</sup> Ed., Morgan Kaufmann, 2005.
2. David Salomon, "data Compression", 3<sup>rd</sup> Edition, Springer, 2004
3. T. Acharya and A.K. Ray, "Image Processing: Principles and Applications" Wiley Interscience, 2005.

### **Pattern Recognition**

Introduction to statistical decision theory, probability-joint distributions and densities, moments of random variables, minimum risk estimators, statistical decision making, Bayes' theorem, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving one-out technique, characteristic curves

Nonparametric decision making, histograms, kernels and window functions, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminant functions, minimum squared error discriminant functions, choosing a decision making technique

Clustering, hierarchical and partitional clustering

Artificial neural networks, nets without hidden layers, nets with hidden layers, the backpropagation algorithm, Hopfield nets, an application: classifying sex from facial images

Image analysis, scene segmentation and labeling, counting objects, following and representing boundaries, projections, Hough transforms, least squares and eigenvector line fitting, shapes of regions, morphological operations, texture

Books

1. Pattern recognition and Image Analysis, Gost and Jost, PHI
2. Pattern Classification. O. Duda, P. E. Hart, D. G. Stokes, Wiley, 2001