INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

IMAGE PROCESSING							
V Semester: CSE (DS)							

Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACDD08	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisites: There are no prerequisites to take this course.								

I. COURSE OVERVIEW:
This course provides a comprehensive understanding of digital image processing, spanning image representation, Fourier transforms, enhancement, restoration, and segmentation techniques. It equips students with essential skills for proficiently working with images in a wide range of applications, from photography to medical imaging.

II. COURSE OBJECTIVES
The students will try to learn
I. The fundamental concepts and mathematical models of digital image processing, including image representation, perception, and geometry.
II. The techniques for image enhancement, restoration, and transformation, using both spatial and frequency domain methods.
III. The image compression and segmentation techniques, applicable in real-world image analysis and computer vision applications.

III. COURSE OBJECTIVES
CO1   Explain the components of a digital image processing system and describe image models, relationships between pixels, and geometric transformations.

CO2   Apply frequency domain techniques, including Fourier, Discrete Cosine, Walsh, Haar, and Hadamard transforms for image filtering.

CO3   Enhance images using techniques such as histogram equalization, smoothing, sharpening, and homomorphic filtering.

CO4   Restore degraded images using methods like inverse filtering, Wiener filtering, and constrained least mean square techniques.

CO5   Implement image compression methods, including lossless and lossy compression techniques such as LZW, transform coding, and wavelet coding.

CO6   Apply image segmentation techniques, including edge detection, thresholding, region-based segmentation, and texture analysis.

IV. COURSE CONTENT:

Module-I: FUNDAMENTALS OF IMAGE PROCESSING (09)

Introduction to digital image processing, Elements of Digital Image Processing system, Visual perception and properties of human eye, Image representation, A simple image model, Some basic relationship between pixels, Some basic relationship between pixels, Image geometry

Module-II: FILTERING IN THE FREQUENCY DOMAIN (08)

Introduction to Fourier Transform, DFT & FFT, Properties of 2D Fourier Transform, Separable Image Transforms –Walsh, Hadamard Transform, Hadamard Transform (Problem), Discrete Cosine Transform, Discrete Cosine Transform, Discrete Cosine Transform (Problem), Haar Transform

Module-III: IMAGE ENHANCEMENT (09)

Image Enhancement - Histogram Modelling, Image Enhancement - Histogram Modelling, Equalization, Equalization and modification, Image smoothing, Image sharpening, Spatial Filtering, Homomorphic filtering for image enhancement, Homomorphic filtering for image enhancement

Module-IV: IMAGE RESTORATION (09)

Model of Image Degradation/Restoration process, Model of Image Degradation/Restoration process, Inverse filtering, Inverse filtering, Least Mean Square (Wiener) filtering, Least Mean Square (Wiener)

filtering, constrained least mean square restoration, constrained least mean square restoration, Constrained least mean square restoration, Singular value decomposition, Recursive filtering

Module-V: IMAGE SEGMENTATION (10)

Image compression models, Lossless compression: Variable length coding, LZW coding, Lossy Compression: Transform coding, Wavelet coding, Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding-Region oriented segmentation and Texture.

V. TEXTBOOKS:

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", 4th Edition, Pearson Education, 2018.
2. Jain A.K., "Fundamentals of Digital Image Processing", Pearson education, 4th Edition, Pearson Education, 2018.

VI. REFERENCE BOOKS:

1. William K Pratt, "Digital Image Processing", John Willey 2001.
2. Millman Sonka, Vaclav Hlavac, Roger Boyle, Broos/Colic, "Image Processing Analysis and Machine Vision" - Thompson Learning, 1999.

VII. WEB REFERENCES:

1. Chanda S., Dutta Majumdar - "Digital Image Processing and Applications", Prentice Hall of India, 2000. Web resources http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT- KANPUR/Digi_Img_Pro/ /.../

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. PowerPoint presentation
11. E-Learning Readiness Videos (ELRV)