# LAHORE COLLEGE FOR WOMEN UNIVERSITY

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## DEPARTMENT OF ELECTRICAL ENGINEERING
## Course Descriptive File

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| 1 | Course Title | Digital Image Processing |
| 2 | Course Code | EE 432 |
| 3 | Credit Hours | Theory = 3 + Practical = 1 |
| 4 | Pre-requisites | Programming Fundamentals, Signals & Systems, Digital Signal Processing |
| 5 | Co-requisites | None |
| 6 | Semester | VII |
| 7 | Resource Person | Dr. Engr. Aqsa Shabbir/Engr. Ayesha Tariq |
| 8 | Contact Hours (Theory) | 3hrs/week + 1hr tutorial |
| 9 | Contact Hours (Lab) | 3hrs/week |
| 10 | Office Hours | Friday: 10:00 to 12:00<br>Monday: 11:00 to 1:00 |
| 11 | Email | aqsa_shabbir@outlook.com |
| 12 | Course Outline as per Scheme of Studies (SoS) | |

- Concept of digital image
- Types of images
- Visual perception
- Light & electromagnetic perception
- Image sensing & acquisition
- Spatial and luminance resolution parameters
- Image sampling and quantization
- Imaging defects, noise, histogram processing
- Spatial filtering, convolution & correlation
- Smoothing & sharpening
- Fourier Transform, Discrete Fourier Transform
- Frequency based filtering
- Contrast enhancement & adjustment
- Noise elimination: smoothing, Histogram equalization, compression & Stretching
- Image Restoration & Reconstruction
- Image segmentation, Segmentation, Feature extraction
- Image Coding & Compression
- Applications

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| 13 | Course Objectives as per SoS |

- To study the image fundamentals and mathematical transforms necessary for image processing.

- To study the image enhancement techniques
- To study image restoration procedures.

| 14 | Books |
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Textbooks:

1. R. C. Gonzales, R. E. Woods, "Digital Image Processing", 4th Edition, Pearson, 2018.
2. R. C. Gonzales, R. E. Woods, S. L. Eddins, "Digital Image Processing using MATLAB", 2nd Edition, Gatesmark Publishing, 2009

Reference book:

1. William K. Pratt, "Introduction to Digital Image Processing", CRC Press, 2013

Journals and Conference Proceedings:

1. IEEE Transactions on Image Processing (TIP)
2. IEEE International Conference on Image Processing (ICIP)
3. IEEE Computer Vision and Pattern Recognition (CVPR)

| 15 | Course Learning Outcomes (CLOs) |
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1. Acquire the basic knowledge of Digital Image Processing. Understand the concepts of digital image analysis and acquisition.
2. Analyze and evaluate the digital image acquisition, perception and processing in order to use them in computer vision, image enhancement and compression.

| 16 | Marks Breakup |
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**Theory**

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| Quizzes/Assignments/Projects | 20% |
| Midterm exam | 25% |
| Terminal exam (3 hours) | 30% |
| Total | **75%** |

**Lab = 25%**

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| Final marks | Theory marks * 0.75 + Lab marks * 0.25 |

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| **Week** | **Topic** | **CLO** | **Taxonomy Level** | **Specific Outcome** | **Contact Hours** | **Assessment** |
| 1 | Introduction and origins of digital image processing. Introduction of fields that use digital image processing (x-ray imaging, gamma ray imaging, industrial imaging etc.). Fundamental steps in digital image processing. | CLO 1 | C1 | To introduce the students to the origins of digital image processing, its wide spectrum of applications and its pervasiveness. | 3 Hours | Assessment 1, Mid-Term Exam |
| 2 | Image formation in human eye. Brightness adaptation and discrimination. Light and the electromagnetic spectrum | CLO 1 | | To provide a basic understanding of how digital images are acquired, represented, manipulated and processed. This serves as a solid platform on which the remaining course is built. | 3 Hours | |
| 3 | Image sensing and acquisition. Image sampling and quantization. Representation of digital images. Spatial and intensity resolution. | CLO 1 | | | 3 Hours | |
| 4 | Image interpolation. Basic relationships between pixels: neighbours of a pixel, adjacency, connectivity, regions and boundaries. Distance measures. | CLO 1 | | | 3 Hours | Mid-Term Exam |
| 5 | Basics of intensity transformation and spatial filtering. Image negatives, log transformations, gamma transformations, piece-wise linear transformations. | CLO 1 | | To study and analyze the basics of image processing in the image plane (spatial domain), in particular intensity transformations | 3 Hours | |

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| 6 | Histogram processing: histogram equalization, histogram matching. Contrast stretching. | CLO 1, CLO 2 | | for the purpose of image enhancement. | 3 Hours | |
| 7 | Mechanics of spatial filtering. Spatial correlation and convolution. Spatial filter masks. | CLO 1, CLO 2 | | | 3 Hours | Assessment 3 |
| 8 | **Mid-Term Exam** | CLO 1 | C2, C4 | | 2 Hours | |
| 9 | Smoothing spatial filters: linear and non-linear filters. | CLO 2 | | To study, analyze and design spatial domain filters for image enhancement and restoration | 3 Hours | Assessment 3, Final-Term Exam |
| 10 | Sharpening spatial filters. Foundations, Laplacian, unsharp masking and high boost filtering. | CLO 2 | | | 3 Hours | |
| 11 | Sampling and Fourier transform of sampled functions. Sampling theorem, aliasing, signal recovery from sampled data. Discrete Fourier transform. | CLO 1, CLO 2 | | To study the basics of 2-D signal processing in frequency domain and its extension to analysis and design of frequency domain filters for image enhancement and restoration. | 3 Hours | Assessment 3, Final-Term Exam |
| 12 | Linear shift invariant systems. 2D impulse and its sifting property. 2D discrete Fourier transform and its inverse. Properties of 2D discrete Fourier transform. | CLO 2 | | | 3 Hours | |
| 13 | Image smoothing and sharpening using frequency domain filters. Ideal high pass and low pass filters. Butterworth and Gaussian filters. | CLO 2 | | | 3 Hours | |
| 14 | Image segmentation fundamentals. Point, line and edge detection. Thresholding | CLO 1, CLO 2 | | To introduce the students to advance topics in digital image processing and | 3 Hours | Assessment 2, Final-Term Exam |

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| | foundations. Region-based segmentation. | | | their utility in designing and implementing systems. | | |
| 15 | Image compression fundamentals. Coding redundancy, spatial and temporal redundancy, fidelity criteria. Some basic compression methods: Huffman coding, LZW coding, arithmetic coding. | CLO 1, CLO 2 | | | 3 Hours | |
| 16 | **Final-Term Exam** | CLO 1, CLO 2 | C2, C4 | | 3 Hours | |

| **18** | **Course Learning Outcomes (CLOs) and Assessment Plan** | |
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| CLO / Activity | CLO 1 | |
| Assessment 1 | C2 | |
| MID TERM EXAM | C2, C4 | |
| Assessment 2 | | |
| Assessment 3 | | |
| FINAL-TERM EXAM | | |