# Birla Institute of Technology & Science, Pilani
## Hyderabad Campus

**SECOND SEMESTER 2023-24**

Course Handout

09-01-2024

*Course No.*  : *EEE F435*
*Course Title*  : Digital Image Processing
*Instructor-in-Charge*  : Dr. Rajesh Kumar Tripathy

1. **Scope and Objective of the Course:**

The course introduces the students to the fundamentals of digital images and various processing techniques that are applied to digital images. It begins with an introduction to the fundamentals of digital images and discusses the various discrete transforms, which are extensively used in image processing. It then discusses the different image processing techniques, such as image enhancement, image segmentation, automatic image classification, and recognition. This course is very helpful for students interested in pursuing research on computer vision, image processing, pattern recognition, and applied artificial intelligence. The OpenCV-based Python software framework will be used in this course to demonstrate different image-processing algorithms. The students need to solve the programming assignments and gain hands-on experience in the industrial applications of digital image processing.

## 2. Textbooks:
T1. Gonzalez, R. C. & R. E. Woods, Digital Image Processing, Pearson Education, 4th ed., 2017

## 3. Reference books/Materials
R1: OpenCV tutorial, https://opencv24-python-tutorials.readthedocs.io/_/downloads/en/stable/pdf/

## 4. Course Plan:

| Lecture No. | Learning Objectives | Topics to be covered | Reference to Text Book |
|---|---|---|---|
| 1-2 | To introduce fundamental concepts and terms associated with digital images. | Introduction and digital image fundamentals. | Chapter 2 |
| 3-5 | To study image enhancement by gray-level transformations | Some basic gray-level transformations | Sec. 3.1, 3.2 |
| 6-7 | To study the Histogram processing of an image | Histogram processing | Sec 3.3 |
| 8-9 | To learn image enhancement by filtering in the spatial domain | Spatial filtering | Sec. 3.4-3.7 |
| 10-11 | Review of Fourier domain techniques | 2D Fourier Transform, 2D DFT, Convolution | Sec. 4.1-4.6 |

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| 12-14 | Filtering in the Fourier domain | Image smoothing and sharpening using Frequency domain filters | Sec. 4.7-4.10 |
|---|---|---|---|
| 15-17 | Image Restoration and Reconstruction | Noise Models, Inverse filtering | Sec. 5.1-5.7 |
| 18-21 | Image Compression | Information Theory, Huffman coding, Basic Compression Methods, JPEG compression | Sec. 8.1-8.2 |
| 22-24 | Morphological Image Processing | Erosion, dilation, Opening closing, Hit-or-miss transformation, some basic morphological algorithms | Sec. 9.1-9.4, 9.5.1-9.5.7 |
| 25-30 | Image Segmentation | Point, line, and edge detection, thresholding | Sec. 10.1-10.3 |
| 31-35 | Image representation and feature extraction | Principal components analysis (PCA), transfer learning-based feature extraction, VGG16, VGG19, ResNet50, InceptionV3 XCeptionNet etc. | Sec 11.1 and Class notes |
| 36 –38 | Applications of Artificial intelligence in digital image processing | U-net-based image segmentation, applications such as optic disc segmentation in the fundus or retinal image, blood vessel segmentation in the fundus image, lung segmentation in chest X-ray images, etc. | Class notes |
| 39 –44 | Image classification | Convolutional neural network, recurrent neural network, self-attention, and vision transformer for image classification | Class notes |

## 5. Evaluation Scheme:

| Component | Duration | Weightage (%) | Marks | Date & Time | Nature of Component |
|---|---|---|---|---|---|
| Mid-Sem Exam | 90 min | 30% | 90 | 11/03 - 4.00 - 5.30PM | Closed Book |
| Programming Assignments using Python (Assignment 1 and Assignment 2) | -------- | 30% | 90 | To be announced | Open Book |
| Comprehensive Exam | 180 min | 40% | 120 | 07/05 AN | Closed Book |

**6. Chamber Consultation Hour:**    To be announced

**7. Notices: Notices concerning this course will be on CMS.**

**8. Make–up Examination:** Make-up will be given on genuine grounds only. Prior application should be made for seeking the make-up examination.

**9. Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester, and no type of academic dishonesty is acceptable.

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Rajesh Kumar Tripathy
**INSTRUCTOR-IN-CHARGE**

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