**NU | NIIT UNIVERSITY**

# COURSE HANDOUT

**Session:** 2025-2026                                          **Sub Session:** Semester II (Jan-Jun)

**Course Name:** Digital Image Processing (EL 302)                          **L/T/P/C:** 3/0/2/4

**Course Incharge:**   Dr. Vikas  Upadhyaya

**Course Faculty:**

Dr. Vikas  Upadhyaya ( VIKAS.UPADHYAYA@NIITUNIVERSITY.IN )

**Registered Batches:**

B.Tech. -  CSE 2021 , CSE 2022 , ECE 2022 , AI and DS 2024 , CSE 2024 , ECE 2024

## Course Description

Digital Image Processing course at UG level introduces the fundamentals of Image Processing. The course will cover a wide range of Image Processing techniques in time and frequency domain. Apart from image processing, video handling will also get covered in the course.

## Course Outcomes

| S.No. | Description |
|-------|-------------|
| CO1 | Examine various types of images, intensity transformations and spatial filtering. |
| CO2 | Develop Fourier transform for image processing in frequency domain. |
| CO3 | Evaluate the methodologies for image morphological processing, restoration, color image processing etc. |
| CO4 | Apply image processing algorithms in real life to create meaningful practical applications. |
| CO5 | Apply the knowledge to develope application oriented Algorithms |

## Course outcome mapping with Programme Outcomes:

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 1 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| CO5 | 1 | 3 | 1 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 |
| Max. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

3 is High, 2 is Moderate, 1 is Low & - is Not Applicable

## AC Approved Course Content

The Academic Council approved course content will be filled in this section by the Academic Office.

## Tentative Lecture Plan/ Activities

| Units | Syllabus Details | Hours required to complete | Course Outcome |
|:---:|---|:---:|:---:|
| 1 | Course overview, Introduction to Digital Image Processing | 1 | CO1 |
| 2 | Image sensing and acquisition | 1 | CO1 |
| 3 | Image sampling and quantization | 1 | CO1 |
| 4 | Neighborhood, adjacency, connectivity between pixels | 1 | CO1, CO4, CO5 |
| 5 | Regions and boundaries in an image, distance measurement | 1 | CO1, CO4, CO5 |
| 6 | Various mathematical tools used in digital image processing | 1 | CO1, CO4, CO5 |
| 7 | Intensity transformation | 2 | CO1, CO4, CO5 |
| 8 | Histogram processing | 1 | CO1, CO4, CO5 |
| 9 | Histogram equalization | 1 | CO1, CO4, CO5 |
| 10 | Histogram matching | 1 | CO1, CO4, CO5 |
| 11 | Local histogram processing | 1 | CO1, CO4, CO5 |
| 12 | Fundamentals of Spatial filtering | 1 | CO2 |
| 13 | Smoothing spatial filters | 1 | CO2, CO4, CO5 |
| 14 | Sharpening spatial filters | 1 | CO2, CO4, CO5 |
| 15 | Edge detection | 1 | CO2, CO4, CO5 |
| 16 | Edge detection- Canny edge detector | 1 | CO2, CO4, CO5 |
| 17 | Edge detection- LoG and DoG | 1 | CO2, CO4, CO5 |
| 18 | Edge Linking and Boundary detection | 1 | CO2, CO4, CO5 |
| 19 | Line detection- Hough transform | 1 | CO2, CO4, CO5 |
| 20 | Sampling and Fourier transform of sampled functions | 1 | CO2 |
| 21 | Discrete Fourier transform | 1 | CO2 |
| 22 | Image processing in frequency domain | 1 | CO2 |
| 23 | Basics of filtering in frequency domain | 1 | CO2 |
| 24 | Image smoothing using frequency domain filters | 1 | CO2, CO4, CO5 |
| 25 | Image sharpening using frequency domain filters | 1 | CO2, CO4, CO5 |
| 26 | Image Restoration: Noise models | 1 | CO3, CO4, CO5 |
| 27 | Restoration in the presence of noise only – Spatial filtering | 1 | CO3, CO4, CO5 |
| 28 | Adaptive filters | 2 | CO3, CO4, CO5 |
| 29 | Color Image processing: Color models | 1 | CO3, CO4, CO5 |
| 30 | Pseudocolor image processing | 1 | CO3, CO4, CO5 |
| 31 | Color transformation | 1 | CO3, CO4, CO5 |
| 32 | Noise in color image: Smoothing and Sharpening | 1 | CO3, CO4, CO5 |
| 33 | Image segmentation based on Color | 1 | CO3, CO4, CO5 |
| 34 | Image compression: Fundamentals | 1 | CO4, CO5 |
| 35 | Basic compression methods: Huffman, Arithmetic, LZW | 1 | CO4, CO5 |
| 36 | Basic compression methods: Run-length, Bit-plane | 1 | CO4, CO5 |
| 37 | Basic compression methods: Pyramids | 2 | CO4, CO5 |
| 38 | Morphological Image Processing: Erosion and Dilation | 1 | CO4, CO5 |
| 39 | Opening, Closing, Hit-or-miss transformation | 1 | CO4, CO5 |
| 40 | Basic Morphological algorithms: Boundary extraction, Hole filling | 1 | CO4, CO5 |

| Total lectures/activities required | 45* | |
|---|---|---|
| *Number of lectures/activities may vary. | | |

## Book Details

### Text Books

TB1. Digital Image Processing by Gonzalez and Woods, Pearson Education, 3rd edition, 2016, ISBN 9789332570320.

### Reference Books

RB1. S. Sridhar, Digital Image Processing, Oxford University Press, 0-19-807078-0.
RB2. S Jayaraman and S Esakkirajan, Digital Image Processing, T Veerakumar, TMH, ISBN 978-0-07-014479-8.
RB3. A. K. Jain, Fundamental of Digital Image Processing, Pearson Education India, ISBN- 9YY255191X

### Online course work/ Massive Open Online Course/ Open source web material

To be updated

## Evaluation Scheme (Theory/ Practical)

| Evaluation Component | Exam Month | Exam Duration (in Hrs) | Mode of Examination | Weighted Marks |
|---|---|---|---|---|
| Attendance | Not Applicable | Not Applicable | Not Applicable | 10.00 |
| Quiz 1 | January | 0.5 | Online with open book | 10.00 |
| Quiz 2 | February | 0.5 | Online with open book | 10.00 |
| Assignment | April | 0.5 | Online with open book | 10.00 |
| Mid Semester Examination | March | 1.5 | Pen-Paper with open book | 20.00 |
| Comprehensive Examination | May | 3 | Pen-Paper with open book | 30.00 |
| Practical - Sessional | Not Applicable | Not Applicable | Not Applicable | 10.00 |

## Mode of Practical Exam

The practical evaluation will be done on the basis of student's performance in the practical assignment during lab session. The students will be given some programming problems which should be solved and shown on the same day in the lab.

There will be TWO SURPRISE Quizzes and ONE SURPRISE ASSIGNMENT conducted during the semester. Zero makeup policy for these assessment components.

## List of Tentative Practical

Exp01. Reading and Writing an Image.
Exp02: Color to Gray scale conversion.
Exp03: Creating Black and White Image.
Exp04: Intensity range adjustment.
Exp05: Contrast Stretching and Bit plane slicing.
Exp06: Intensity transformations: Anti-log, log, negative, nth root, power.
Exp07: Affine Transformations: Scaling, Shear, Translation.
Exp08: Histogram: stem histogram, plot histogram, histogram using imhist, histogram equalization.
Exp09. Correlation and Convolution in Filtering.
Exp10. Smoothing Filters-Gaussian, avg, median filters.
Exp11. Gradient Filters - prewitt, Sobel, Roberts filters.
Exp12. Morphological processing: Erosion, dilation, closing, Opening, boundary detection

## Course outcome mapping with evaluation components:

| CO | Assignment | Comprehensive Examination | Mid Semester Examination | Practical - Sessional | Quiz 1 | Quiz 2 |
|---|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| CO2 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 1 | 2 |
| CO5 | 1 | 3 | 1 | 3 | 1 | 1 |
| Max. | 3 | 3 | 3 | 3 | 3 | 3 |

**3 is High, 2 is Moderate, 1 is Low & - is Not Applicable**

## Make up Policy

Students who are likely to miss a component of evaluation due to any genuine reason may be given a make-up for that component by the Course In-Charge. The students are required to approach the Course In-Charge immediately for the same before the conduct of the evaluation component. It is the responsibility of the student to approach the Course In-Charge. The Course In-Charge will not allow makeup, if a student approaches 7 days after the evaluation component (Student Handbook R 35).

## Plagiarism

We are committed to uphold the standards of academic integrity and honesty. Plagiarism in any form is unacceptable and will be treated seriously (Student Handbook R 49).

## Grading Policy

The marks obtained in all evaluation components will be aggregated, and the total will be converted into a letter grade or report in accordance with NIIT University's guidelines. Grading is relative and is generally aligned with the class average. Mid-Semester grades will be announced after the evaluation of the Mid-Semester Examination, as outlined in the Student Handbook (R 40 and R 41).

## University Attendance Policy

As per attendance policy of NIIT University. For more details, kindly refer to the attendance policy in the student handbook.

## Consultation Hours

All information regarding course will be posted on NUgget (NU learn portal). Students are requested to check NUgget for any updates twice a day. The student may approach the Course-In-Charge Monday - Friday (Office hours) for any clarification or removal of their difficulties. Dedicated timeslot for doubt clarification: Wednesdays (3:30-5:30 PM).