|  | **Daffodil International University**  **Department of Computer Science and Engineering (CSE)**  **Course Outline** | | |  |
| --- | --- | --- | --- | --- |
| **Course Code:** | CSE 427 | | | |
| **Course Title:** | Digital Image Processing | | | |
| **Program:** | B.Sc. in CSE | | | |
| **Faculty:** | Faculty of Science and Information Technology (FSIT) | | | |
| **Semester:** | Spring 2023 | **Year:** | 2023 | |
| **Credit:** | 3.0 | **Contact Hour:** | 3.0 | |
| **Course Level:** | Level 3 Term 3 | **Prerequisite:** | No | |
| **Course Category:** | Core Engineering | | | |
| **Instructor Name:** | Naznin Sultana | | | |
| **Designation:** | Associate Professor | | | |
| **Email:** | naznin.cse@diu.edu.bd | | | |
| **Office Address:** | Room 508, AB4, DSC | | | |

1. **Course Rationale**

This course introduces the fundamentals of Digital Image Processing techniques and its applications. The students will be able to learn various types of digital image processing techniques that are widely used in medical research and scientific analysis. Since This course is designed to cover Digital Image Fundamentals; Image Transformation; Image Enhancement; Image Restoration; Image Compression; Image Segmentation; Morphological Image Processing; Moment s and Object Recognition and Interpretation.

* 1. **Course Objective**

This course aims the following:

* To introduce the basic concepts of digital image processing operations and their applications in different areas.
* To develop skills among the learners of image processing.
* To understand the different image processing techniques.
* To understand the different image filtering and their use.
* To be able to analze image in different domains.
  1. **Course Outcomes (CO’s)**

On the successful completion of the course, students will be able to,

 **CO1 :**Able to define the different modelling terms by analyzing the system or the data that is present.

 **CO2 :**Able to learn different mathematical model and their application in simulation.

 **CO3 :**Able to implement the model and from the results check for the validity of the model and correctness of the assumptions present in the model.

 **CO4 :**Able to analyze the outcomes and make predictions.

| **Course Outcome** | Blooms Taxonomy | KP | CP | CA |
| --- | --- | --- | --- | --- |
| **CO1:** Able to define the different modelling terms by analysing the system or the data that is present. | Understand | K1-K4 | 1 |  |
| **CO2:** Able to analyze different mathematical model and their application in simulation.  . | Analyze | 1 | 1 |
| **CO3:** Able to apply different image processing techniques in different applications and research work. | Apply | K5 | 2 |
| **CO4:** Able to analyze the outcomes of different image processing operations. | Analyze | K8 | 2 |  |
| . |  |  |  |  |
| KP: Knowledge Profile, CP: Complex Problem, CA: Complex Activities | | | | |

* 1. **Program Outcomes (PO’s):**

Program Outcomes are reported in Appendix-I.

* 1. **Mapping of Course Learning Outcomes to Program Learning Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **PLO-1** | **PLO-2** | **PLO-3** | **PLO-4** | **PLO-5** | **PLO-6** | **PLO-7** | **PLO-8** | **PLO-9** | **PLO-10** | **PLO-11** | **PLO-12** |
| **CLO-1** |  | √ |  |  |  |  |  |  |  |  |  |  |  |
| **CLO-2** |  |  | √ |  |  |  |  |  |  |  |  |  |  |
| **CLO-3** |  |  |  | √ |  |  |  |  |  |  |  |  |  |
| **CLO-4** |  |  |  |  | √ |  |  |  |  |  |  |  |  |
| **CLO-5** |  |  |  |  |  | √ |  |  |  |  |  |  |  |

[Tick Mark is used to avoid confusion]

* 1. **Mapping Course Learning Outcome (CLOs) with the Teaching-Learning and Assessment Strategy:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CLO’s** | **Teaching Learning Strategy** | **Assessment Strategy** | **Corresponding**  **PO number** | **Domain**  **Level/Learning**  **Taxonomy** |
| CLO1 | Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion | Class Test/Assignment/ Midterm examination | PO1 | L2 |
| CLO2 | Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion | Class Test/Assignment/ Midterm examination | PO2 | L2 |
| CLO3 | Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion | Class Test/Assignment/ Midterm examination | PO3 | L3 |
| CLO4 | Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion | Class Test/Assignment/ Midterm examination | PO4 | L4 |
|  |  |  |  |  |

* 1. **CO Assessment Scheme**

| **Assessment Task** | **CO’s** | | | | | **Mark**  **(Total=100)** |
| --- | --- | --- | --- | --- | --- | --- |
| **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| Attendance |  |  |  |  |  | 7 |
| Class Test (CT1, CT2, CT3) |  |  |  |  |  | 15 |
| Assignment |  |  |  |  |  | 5 |
| Presentation |  |  |  |  |  | 8 |
| Midterm Examination | 5.0 | 6.0 | 14.0 |  |  | 25 |
| Semester Final Examination |  |  | 20.0 | 10.0 | 10.0 | 40 |
| Total Mark | 5.0 | 6.0 | 34.0 | 10.0 | 10.0 | 100 |

# **Strategies and approaches to learning**

# **Teaching and Learning Activities (TLA)**

| **TLA1** | Lectures twice a week using multimedia of different topics. |
| --- | --- |
| **TLA2** | Active discussion in class regarding efficient solving of the logical and mathematical problems. |
| **TLA3** | Group discussion and presentation regarding diverse problems and corresponding lectures. |
| **TLA4** | Evaluation of class performances to reach each student in a class for every topic. |

1. **Course Schedule and Structure**
   1. **Textbook**
2. Digital Image Processing, Rafael C. Gonzalez
   1. **Reference Books**
3. Fundamental of Digital Image Processing, Anil K. Jain
4. Computer Vision, Dana H. Ballard
5. Hands-on Image Processing with Python, Sandipan Dey
   1. **Course Plan/Lesson Plan**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Week/Lesson**  **(hour)** | **Discussion Topic and Book Reference** | **Student Activities during Online and Onsite and TLA** | **Mapping with CLO and PLO** | **Assessment Plan** |
| **Week-1**  Lesson 1 & 2 [2 Hours] | **Lesson 1:**  Introduction to digital image processing, Applications, Research, [Gonzalez, Chapter-1, Page (23-39)]  **Lesson 2:**  Introduction to digital image processing, Applications, Research, [Gonzalez, Chapter-1, Page (40-52)] | Lesson 1, 2: Online/ Onsite discussion; Review Feedback online; Using Interactive content e.g.  Voice over PPT, PPT, Video, H5P; TLA1, TLA2 | CLO 1,  PLO-1 |  |
| **Week-2**  Lesson 3 & 4 [2 Hours] | **Lesson 3**  Elements of visual perception, Light and electromagnetic spectrum, Image sensing and acquisition [Gonzalez, Chapter-2, Page (58-73)]  **Lesson 4:**  Image sampling and quantization, Some basic relationship between pixels, Mathematical tools used in digital image processing [Gonzalez, Chapter-2, Page (74-119)] | Lesson 3, 4: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA2 | CLO 1, PLO-1 | **Class Test** |
| **Week-3**  Lesson 5 & 6 [2 Hours] | **Lesson 5:**  Color fundamentals, Color models, [Gonzalez, Chapter-6, Page (417-435)]  **Lesson 6:**  Color fundamentals, Color models, [Gonzalez, Chapter-6, Page (417-435)] | Lesson 5, 6: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA2, TLA3 | CLO 1,2  PLO-1,2 |  |
| **Week-4**  Lesson 7 & 8 [2 Hours] | **Lesson 7:**  Pseudocolor image processing, Basics of full color image processing[Gonzalez, Chapter-6, Page (436-447)]  **Lesson 8:**  Pseudocolor image processing, Basics of full color image processing[Gonzalez, Chapter-6, Page (436-447)] | Lesson 7, 8: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA2, TLA3 | CLO 1,2  PLO-1,2 | **Assignment** |
| **Week-5**  Lesson 9 & 10 [2 Hours] | **Lesson 9:**  Basics of intensity transformation and spatial filtering, Some basic intensity transformation functions [Gonzalez, Chapter-3, Page (127-141)]  **Lesson 10:**  Basics of intensity transformation and spatial filtering, Some basic intensity transformation functions [Gonzalez, Chapter-3, Page (127-141)] | Lesson 9 & 10: Online/Onsite discussion; Review Feedback online; Using Interactive content e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA2, TLA3 | CLO 1,2  PLO-1,2 |  |
| **Week-6**  Lesson 11 & 12 [2 Hours] | **Lesson 11:**  Basics of intensity transformation and spatial filtering, Some basic intensity transformation functions [Gonzalez, Chapter-3, Page (127-141)]  **Lesson 12:**  Basics of intensity transformation and spatial filtering, Some basic intensity transformation functions [Gonzalez, Chapter-3, Page (127-141)] | Lesson 11 & 12: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA2, TLA3 | CLO 1,2  PLO-1,2 | **Presentation** |
| **Week-7**  Lesson 13 & 14 [2 Hours] | **Lesson 13:**  Histogram Processing, Fundamentals of spatial filtering, Smoothing and sharpening spatial filter [Gonzalez, Chapter-3, Page (142-183)] [(Online Materials: Research Paper)]  **Lesson 14:**  Histogram Processing, Fundamentals of spatial filtering, Smoothing and sharpening spatial filter [Gonzalez, Chapter-3, Page (142-183)] [(Online Materials: Research Paper)] | Lesson 13, 14: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA2, TLA3 | CLO 2  PLO- 2 |  |
| **Week-8**  Lesson 15 & 16 [3 Hours] | **Lesson 15:**  Histogram Processing, Fundamentals of spatial filtering, Smoothing and sharpening spatial filter [Gonzalez, Chapter-3, Page (142-183)] [(Online Materials: Research Paper)]  **Lesson 16:**  Histogram Processing, Fundamentals of spatial filtering, Smoothing and sharpening spatial filter [Gonzalez, Chapter-3, Page (142-183)] [(Online Materials: Research Paper)] | Lesson 15, 16: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA3 | CLO 2  PLO-2 |  |
| **Week-9**  Lesson 17 & 18 [2 Hours] | **Lesson 17:**  Filtering in frequency domain, Sampling and fourier transform of sampled function [Gonzalez, Chapter-4, Page (224-240)]  **Lesson 18:**  DFT, 2D DFT, Image smoothing and sharpening in frequency domain [Gonzalez, Chapter-4, Page (242-310)] | Lesson 17, 18: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA3 | CLO 3  PLO-3 | **Midterm Exam** |
| **Week-10**  Lesson 19 & 20 [2 Hours] | **Lesson 19:**  Point, line and edge detection Thresholding, Region based segmentation, Segmentation using morphological watersheds  [Gonzalez, Chapter-10, Page (712-797)]  **Lesson 20:**  Point, line and edge detection Thresholding, Region based segmentation, Segmentation using morphological watersheds  [Gonzalez, Chapter-10, Page (712-797)] | Lesson 19, 20: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA4 | CLO 4  PLO- 4 |  |
| **Week-11**  Lesson 21 & 22 [2 Hours] | **Lesson 21:**  Point, line and edge detection Thresholding, Region based segmentation, Segmentation using morphological watersheds  [Gonzalez, Chapter-10, Page (712-797)]  **Lesson 22:**  Point, line and edge detection Thresholding, Region based segmentation, Segmentation using morphological watersheds  [Gonzalez, Chapter-10, Page (712-797)] | Lesson 21, 22: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA3 | CLO 4  PLO- 4 | **Class Test** |
| **Week-12**  Lesson 23 & 24 [2 Hours] | **Lesson 21:**  Point, line and edge detection Thresholding, Region based segmentation, Segmentation using morphological watersheds  [Gonzalez, Chapter-10, Page (712-797)]  **Lesson 22:**  Point, line and edge detection Thresholding, Region based segmentation, Segmentation using morphological watersheds  [Gonzalez, Chapter-10, Page (712-797)] | Lesson 23, 24: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA4 | CLO 4  PLO-4 |  |
| **Week-13**  Lesson 25 & 26 [2 Hours] | **Lesson 25:**  Image restoration and reconstruction, Restoration in the presence of noise only, Periodic noise reduction by frequency domain filtering [Gonzalez, Chapter-5, Page (334-360)]  **Lesson 26:**  Inverse filtering, MMSE filtering [Gonzalez, Chapter-5, Page (373-378)] | Lesson 25, 26: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA1, TLA4 | CLO 4, 5  PLO-4, 5 | **Class Test** |
| **Week-14**  Lesson 27 & 28[3 Hours] | **Lesson 27:**  Image compression fundamentals, Image compression models, Image formats, Containers, Compression standards [Gonzalez, Chapter-8, Page (548-563)]  **Lesson 28:**  Image compression fundamentals, Image compression models, Image formats, Containers, Compression standards [Gonzalez, Chapter-8, Page (548-563)] | Lesson 27, 28: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA3 | CLO 4  PLO-4 |  |
| **Week-15**  Lesson 29 & 30[2 Hours] | **Lesson 29:**  Compression methods, Huffmann coding, Arithmetic coding, LZW coding, Run length coding, Predictive coding [Gonzalez, Chapter-8, Page (564-630)]  **Lesson 30:**  Compression methods, Huffmann coding, Arithmetic coding, LZW coding, Run length coding, Predictive coding [Gonzalez, Chapter-8, Page (564-630)] | Lesson 29, 30: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA3 | CLO 4  PLO-4 |  |
| **Week-16**  Lesson 31 & 32[2 Hours] | **Lesson 31:**  Erosion and dilation, Opening and closing [Gonzalez, Chapter-9, Page (652-660)]  **Lesson 32:**  Some basic morphological algorithms [Gonzalez, Chapter-9, Page (664-680)] | Lesson 31, 32: Online/Onsite discussion; Review Feedback online; Using Interactive content  e.g. Voice over PPT, PPT, Video, H5P; TLA3 | CLO 4  PLO-4 | **Final Exam** |
| **Week-17**  Lesson 33 & 34[2 Hours] | **Lesson 33:**  Representations, Boundary descriptor [Gonzalez, Chapter-11, Page (818-843)]  **Lesson 34:**  Regional descriptors, Use of principal components for descriptions [Gonzalez, Chapter-11, Page (844-870)] |  | CLO 4  PLO-4 |  |
| **Week-18**  Lesson 35 & 36[2 Hours] | **Lesson 35:**  Pattern and pattern classes, Recognition based on decision theoretic methods [Gonzalez, Chapter-12, Page (883-924)]  **Lesson 36:**  Structural methods [Gonzalez, Chapter-12, Page (925-927)] |  | CLO 1  PLO-1 |  |

1. **Assessment Methods**
   1. **Grading System**

| **Numerical Grade** | **Letter Grade** | **Grade Point** |
| --- | --- | --- |
| 80-100 | A+ | 4.00 |
| 75-79 | A | 3.75 |
| 70-74 | A- | 3.50 |
| 65-69 | B+ | 3.25 |
| 60-64 | B | 3.00 |
| 55-59 | B- | 2.75 |
| 50-54 | C+ | 2.50 |
| 45-49 | C | 2.25 |
| 40-44 | D | 2.00 |
| Less than 40 | F | 0.00 |

1. **Additional Support for Students**

* Student Portal:

<http://studentportal.diu.edu.bd/>

* Academic Guidelines

<https://daffodilvarsity.edu.bd/article/academic-guidelines>

* Rules and Regulations of DIU

<https://daffodilvarsity.edu.bd/article/rules-and-regulation>

* Career Development Center:

<https://cdc.daffodilvarsity.edu.bd/>

* For general queries:

<http://daffodilvarsity.edu.bd/>

**Program Outcomes and Assessment**

Program Outcomes (POs) are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills and attitudes that students acquire while progressing through the program. The program must demonstrate that by the time of graduation, students have attained a certain set of knowledge, skills and behavioral traits to some acceptable minimum level. The BAETE specifically requires that students acquire the following graduate attributes.

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

**(PO2: Problem analysis:** Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.

**PO3: Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.

**PO4: Investigation:** Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

**PO5: Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6: The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

**PO7: Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.

**PO9: Individual work and teamwork:** Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.

**PO10: Communication:** Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.

**PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work as a member or a leader of a team to manage projects in multidisciplinary environments.

**PO12: Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.