Academic Year: 2022-23	Semester:6th
Course Name: DIP	Course Code:18AI62
Total Contact hours: 50	Credits:4
SEE Marks: 60; CIE:40	Total Marks: 100
Course Plan Author: Prema C	Date: 25/03/23

Course Prerequisites:

- Differential Equations
- Probability and Statistics
- Linear Algebra
- Calculus
- Signals and systems
- Digital Electronics (just basic)
- Basic Programming skills (C++, MATLAB or any).

Course Learning Objectives: This course will enable students to:

- Understand the fundamentals of digital image processing
- Understand the image transform used in digital image processing
- Understand the image enhancement techniques used in digital image processing
- Understand the image restoration techniques and methods used in digital image processing
- Understand the Morphological Operations and Segmentation used in digital image processing Course

Outcomes:

CO Number	Course Outcome At the end of the course, student should be able to . . .	Blooms' Level
CO1	Understand, Ascertain and describe the basics of image processing concepts through mathematical interpretation.	L2
CO2	Apply image processing techniques in both the spatial and frequency (Fourier) domains.	L3
CO3	Demonstrate image restoration process and its respective filters required.	L3
CO4	Understand and Apply image processing techniques in color images, different shapes with the support of mathematical functions	L3
CO5	Design image analysis techniques in the form of image segmentation and to evaluate the Methodologies for segmentation.	L3

2. CO – PO Mapping

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	0	1	0	1	2					2	1	1	
CO2	3	3	2	2	1	1	1					2	1	1	
CO3	3	3	2	2	1	1	1					2	1	1	

CO4	3	3	2	2	1	1	1					2	1	1	
CO5	3	3	2	2	1	1	1					2	1	1	

Program Outcome and Program Specific Outcome:

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, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and 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 the public health and safety, and the cultural, societal, and environmental considerations
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the 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 the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	**Environment and sustainability:** Understand the impact of the 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 and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and 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 and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1	Graduates will have the ability to adapt, contribute and innovate ideas in the field of Artificial Intelligence and Machine Learning
PSO2	To provide a concrete foundation and enrich their abilities to qualify for Employment, Higher studies and Research in various domains of Artificial Intelligence and Machine Learning such as Data Science, Computer Vision, Natural Language Processing with ethical values
PSO3	Graduates will acquire the practical proficiency with niche technologies and open source platforms and to become Entrepreneur in the domain of Artificial Intelligence and Machine Learning

Course Content (Syllabus) :

DIGITAL IMAGE PROCESSING **(Effective from the academic year 2018 -2019)** **SEMESTER – VI**			
Subject Code	18AI62	**CIE Marks**	40
Number of Contact Hours/Week	3:2:0	**SEE Marks**	60
Total Number of Contact Hours	50	**Exam Hours**	03

CREDITS –4

- **Course Learning Objectives:** This course will enable students to:
- Understand the fundamentals of digital image processing
- Understand the image transform used in digital image processing
- Understand the image enhancement techniques used in digital image processing
- Understand the image restoration techniques and methods used in digital image processing
- Understand the Morphological Operations and Segmentation used in digital image processing

Module-1	**Contact Hours.**
Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations. [Text1: Chapter 1 and Chapter 2: Sections 2.1 to 2.5, 2.6.2]	10
RBT: L1,L2	
Module-2	
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering,-Smoothing Spatial Filters, Sharpening Spatial Filters **Frequency Domain**: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, and Selective Filtering. [Text1: Chapter 3: Sections 3.2 to 3.6 and Chapter 4: Sections 4.2, 4.5 to4.10]	10
RBT: L1,L2, L3	
Module-3	
Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, and Constrained Least Squares Filtering. [Text1: Chapter 5: Sections 5.2, to 5.9]	10
RBT: L1,L2, L3	
Module-4	
Color Image Processing: Color Fundamentals, Color Models, and Pseudo-color Image Processing. **Wavelets:** Background, Multi resolution Expansions. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing,	10

The Hit-or-Miss Transforms and Some Basic Morphological Algorithms. [Text1: Chapter 6: Sections 6.1 to 6.3, Chapter 7: Sections 7.1 and 7.2,Chapter 9: Sections 9.1 to 9.5]	
RBT: L1,L2, L3	
Module-5	
Segmentation: Introduction, classification of image segmentation algorithms, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, Corner Detection, and Principles of Thresholding. **Representation and Description:** Representation, and Boundary descriptors. [Text2: Chapter 9: Sections 9.1, to 9.7 and Text 1: Chapter 11: Sections 11.1and 11.2]	10
RBT: L1,L2, L3	

Course Outcomes: At the end of the course students should be able to:

- Understand, Ascertain and describe the basics of image processing concepts through mathematical interpretation.
- Apply image processing techniques in both the spatial and frequency (Fourier)domains.
- Demonstrate image restoration process and its respective filters required.
- Design image analysis techniques in the form of image segmentation and toevaluate the Methodologies for segmentation.
- Conduct independent study and analysis of Image Enhancement techniques.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice Hall, 2008.
2. S. Sridhar, Digital Image Processing, Oxford University Press, 2nd Edition, 2016.

Reference Books:

1. Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, TataMcGraw Hill 2014.
2. Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004.

Schedule of Instruction:

S.NO	Class No	Module	Topic planned	Reference & Text Book, (Page no.)	Course Outcome	Delivery mode
1.		Module 1	Introduction to Digital Image Processing		C01	PPT&BB
2.	1		**Module-1-DIP Fundamentals**		C01	PPT&BB
3.	2		Digital Image Fundamentals: What is Digital Image Processing?	T1-1	C01	PPT&BB
4.	3		Origins of Digital Image Processing, Examples of fields that use DIP	T1-3	C01	PPT&BB
5.	4		Fundamental Steps in Digital Image Processing	T1-25	C01	PPT&BB
6.	5		Components of an Image Processing System	T1-28	C01	PPT&BB
7.	6		Elements of Visual Perception,	T1-36	C01	PPT&BB
8.	7		Image Sensing and Acquisition	T1-46	C01	PPT&BB
9.	8		Image Sampling and Quantization	T1-52	C01	PPT&BB
10.	9		Some Basic Relationships between Pixels	T1-68	C01	PPT&BB
11.	10		Linear and Nonlinear Operations	T1-73	C01	PPT&BB
12.	11	Module 2	**Module 2: Spatial Domain**:	T2-104	C02	PPT&BB
13.	12		Some Basic Intensity Transformation Functions	T2-105	C02	PPT&BB
14.	13		Histogram Processing	T2-120	C02	PPT&BB
15.	14		Fundamentals of Spatial Filtering	T1-144	C02	PPT&BB
16.	15		Smoothing, Spatial Filters	T1-152	C02	PPT&BB
17.	16		Sharpening Spatial Filters	T1-157	C02	PPT&BB
18.	17		Sharpening Spatial Filters	T1-160	C02	PPT&BB
19.	18		Frequency Domain: Preliminary Concepts	T1-199	C02	PPT&BB
20.	19		The Discrete Fourier Transform (DFT) of Two Variables	T1-219	C02	PPT&BB
21.	20		Properties of the 2-D DFT	T1-236	C02	PPT&BB
22.	21		Filtering in the Frequency Domain	T1-255	C02	PPT&BB
23.	22		Image Smoothing and Image Sharpening Using Frequency Domain Filters	T1-269	C02	PPT&BB
24.	23		Selective Filtering.	T1-294	C02	PPT&BB

25.	24	**Module 3**	**Module 3 –Restoration ,Noise models**	T1-312	C03	PPT&BB
26.	25		Restoration in the Presence of Noise Only using Spatial Filtering	T1-322	C03	PPT&BB
27.	26		Linear Position-Invariant Degradations	T1-343	C03	PPT&BB
28.	27		Estimating the Degradation Function	T1-346	C03	PPT&BB
29.	28		Inverse Filtering	T1-351	C03	PPT&BB
30.	29		Minimum Mean Square Error (Wiener) Filtering	T1-352	C03	PPT&BB
31.	30		Constrained Least Squares Filtering	T1-357	C03	PPT&BB
32.	31		Restoration in the Presence of Noise Only using Frequency Domain Filtering	T2-335	C03	PPT&BB
33.	32		University question paper Discussion		C03	PPT&BB
34.	33	**Module 4**	**Module 4: Introduction**		C04	PPT&BB
35.	34		Color Image Processing: Color Fundamentals	T1-395	C04	PPT&BB
36.	35		Color Models	T1-401	C04	PPT&BB
37.	36		Pseudo-color Image Processing	T1-414	C04	PPT&BB
38.	37		Wavelets: Background,	T1-462	C04	PPT&BB
39.	38		Multi resolution Expansion	T1-477	C04	PPT&BB
40.	39		Morphological Image Processing : Preliminaries	T1-628	C04	PPT&BB
41.	40		Erosion and Dilation	T1-630	C04	PPT&BB
42.	41		Opening and Closing,	T1-635	C04	PPT&BB
43.	42		The Hit-or-Miss Transforms	T1-640	C04	PPT&BB
44.	43		Some Basic Morphological Algorithms-Boundary Extraction	T1-642	C04	PPT&BB
45.	44		Some Basic Morphological Algorithms-Thickening	T1-650	C04	PPT&BB
46.	43	**Module 5**	**Module :5 Segmentation**	T1-689	C05	PPT&BB
47.	44		Classification of image segmentation algorithms	T1-746	C05	PPT&BB
48.	45		Detection of Discontinuities	T1-757	C05	PPT&BB
49.	46		Edge Detection	T1-763	C05	PPT&BB
50.	47		Hough Transforms	T1-782	C05	PPT&BB
51.	48		Shape Detection	T1-792	C05	PPT&BB
52.	49		Corner Detection	T1-795	C05	PPT&BB
53.	50		Principles of Thresholding	T1-800	C05	PPT&BB

Textbooks	
T1	Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice Hall, 2008.
T2	S. Sridhar, Digital Image Processing, Oxford University Press, 2ndEdition, 2016.
Reference books	
R1	Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, TataMcGraw Hill 2014.
R2	Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004.

Web links and Video Lectures (e-Resources):	
1	https://www.javatpoint.com/digital-image-processing-tutorial
2	https://www.tutorialspoint.com/dip/index.html
3	https://sites.google.com/skit.org.in/18ai62/home

Assessment Schedule:

Sl.No.	Assessment type	Contents	CO	Duration In Hours	Marks	Date & Time
1.	**CIE Test 1**	Module 1,2	CO1,CO2	01:15	30	
2.	**CIE Test 2**	Module 3,4	CO3,CO4	01:15	30	
3.	**CIE Test 3**	Module 5	CO5	01:15	30	
4.	**Assignment 1**	Module 1,2	CO1,CO2	-	10	
5.	**Assignment 2**	Module 3,4	CO3,CO4	-	10	
6.	**Seminar**	Module 5	CO5	-	10	
7.	**Semester End Examination**	Module 1,2,3,4,5	CO1 To CO5	03.00	100	

Module 1,2,3,4 & 5

CIE + SEE = 40 + 60 = 100 marks

Faculty In-charge
Prema C

DAC Chairman