CMR ENGINEERING COLLEGE
Kandlakoya (V), Medchal Road, Hyderabad – 501401

Department of Electronics and Communication Engineering

COURSE FILE

Sub: DIGITAL IMAGE PROCESSING   A.Y.2022-23

Year: IV YEAR B.Tech I Semester

CONTENTS

Contents of Course file

1. Department vision & mission
2. List of PEOs and Pos PSO's
3. Mapping of course out comes with POs
4. Syllabus copy
5. Individual time table
6. Session plan
7. Session execution log
8. Assignment Questions and innovative assignments
9. Sample assignment script
10. Mid exam question papers
11. Scheme of evaluation
12. Sample mid answer script
13. Unit-wise course material
14. Material collected from Internet/Websites
15. Power point presentations
16. Innovation teaching methods (if any)
17. Previous question papers
8. References (Text books/websites/Journals)

1. Vision & Mission of the Department:

Vision

To promote excellence in technical education and scientific research in electronics and communication engineering for the benefit of society.

Mission

- To impart excellent technical education with state of art facilities inculcating values and lifelong learning attitude.
- To develop core competence in our students imbibing professional ethics and team spirit.
- To encourage research benefiting society through higher learning

2. PEOs & POs

PEO

1. Excel in professional career & higher education in Electronics & Communication Engineering and allied fields through rigorous quality education.
2. Exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning.
3. Solve real life problems relating to Electronics & Communications Engineering for the benefits of society.

PSO

1. Ability to apply concepts of Electronics & Communication Engineering to associated research areas of electronics, communication, signal processing, VLSI, Embedded systems
2. Ability to design, analyze and simulate a variety of Electronics & Communication functional elements using hardware and software tools along with analytic skills

POs

1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2	**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.

3	**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.
4	**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.
5	**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.
6	**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.
7	**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.
8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**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.
11	**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.
12	**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.

3. **Mapping of course out comes with POs**

Course Name: DIGITAL IMAGE PROCESSING (EC612PE):

Course Code.CO No. EC612PE	Course Outcomes (CO's)
At the end of the course student will be able to	
CO.1	Exploration of the limitations of the computational methods on digital images.
CO.2	Expected to implement the spatial and frequency domain image transforms onenhancement and restoration of images.
CO.3	Elaborate understanding on image enhancement techniques.
CO.4	Expected to define the need for compression and evaluate the basic compressionalgorithms.

Course Outcome (CO)-Program Outcome (PO) Matrix:

CO's/ PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO.1	3	3	2	-	-	-	-	-	-	-	-	-
CO.2	3	3	-	-	-	-	-	-	-	-	-	-
CO.3	-	2	3	2	-	-	-	-	-	-	-	-
CO.4	-	-	3	2	-	-	-	-	-	-	-	-
CO.5	-	-	3	2	-	-	-	-	-	-	-	-

Course Outcome (CO)-Program Specific Outcome (PSO) Matrix:

CO's/ PSO's	PSO1	PSO2
CO.1	2	3
CO.2	3	2
CO.3	3	3
CO.4	2	3
CO.5	3	2

4. **Syllabus Copy and Suggested/Reference Books**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech ECE-I SEM   **L**
                                                    T/P/C

                                                                                                    3 0
                                                    0 3

DIGITAL IMAGE PROCESSING

UNIT – I: Digital Image Fundamentals & Image Transforms: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels. Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform. UNIT – II: Magnetostatics: Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law.

UNIT – II: Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering. Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

UNIT – III: IMAGE RESTORATION:Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT – IV:Detection of Discontinuities, Edge Linking And Boundary Detection, thresholding, Region Oriented Segmentation. Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss All Transformation.

UNIT - V Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

<u>**TEXT BOOK**</u>:

1 Digital Image Processing - Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008 2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar- MC GRAW HILL EDUCATION, 2010.
<u>**REFERENCE BOOK:**</u>

1. . Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools - Scotte Umbaugh, 2nd Ed, CRC Press, 2011 2. Digital Image Processing using MATLAB – Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, 2nd Edition, MC GRAW HILL EDUCATION, 2010. 3. Digital Image Processing and Computer Vision – Somka, Hlavac, Boyle- Cengage Learning (Indian edition) 2008. 4. Introductory Computer Vision Imaging Techniques and Solutions- Adrian low, 2008, 2 nd Edition

2. **INDIVIDUAL TIME TABLE**

SUBJECT: DIP   **SECTION:IV(A&B)**   **NAME: CH.PRIYANKA**

DAY/TIME	9.10-10.10	10.10-11.00	11.00-11.50	11.50-12.40	12.40-01.20	01.20-2.10	2.10-3.00	3.00-3.50
MON			DIP-A					
TUE	DIP-B							
WED		DIP-A			L U N C H			
THU						DIP-B		
FRI	DIP-B					DIP-A		
SAT		DIP-A				DIP-B		

5. SESSION PLAN

UNIT No.	UNIT Title	No. of Lectures Required
Unit-I	DIGITAL IMAGE FUNDAMENTALS	17
Unit-II	IMAGE ENCHANCEMENT	8
Unit-III	IMAGE RESTORATION	8
Unit-IV	IMAGE SEGMENTATION	15
Unit-V	IMAGE COMPRESSION	9

6. Detailed Lecture Plan

Name of the topic	Sub topics	No. of classes	Text books	Remarks
UNIT I				
IMAGE FUNDAMENTALS	Digital Image Fundamentals,	L1	T1	
	Sampling and Quantization,	L2	T1,R2	
	Relationship between Pixels	L3	T1,R1	
	. Image Transforms	L4	T1,R2	
	: 2-D FFT,	L5	T1,R1	
	Properties,	L6	T1,R1	
	Walsh Transform,	L7, L8	T1,R1	

	Hadamard Transform,.	L9,L10	T1,R1	
	Discrete Cosine Transform,	L11	T1,R2	
	Haar Transform,	L12	T1,R2	
	Slant Transform,	L13	T1,R1	
	Hotelling Transform	L14	T1,R1	
	PROBLEMS	L15	T1,R1	
	DCT-PROBLEMS	L16	T1,R1	
	EYE DIAGRAM	L17	T1,R1	
	No. of classes required: **17**			
UNIT II				
IMAGE ENHANCEMENT	Image Enhancement (Spatial Domain):	L18	T1	
	Introduction,	L19,L20	T1	
	Image Enhancement in Spatial Domain,	L21	T2,R1	
	Enhancement through Point Processing,	L22,L23	**T1,R1**	
	Types of Point Processing,	L24	**T2**	
	Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or	L25	**T1**	
	Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering.	L26	**T1,T2,R1**	
	Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) and	L27	T2	
	No. of classes required:8			
UNIT III				

IMAGE RESTORATION	Degradation Model, Squares Restoration,	L26	**T1,R1**	
	Filtering	L27,L28	**T1,R1**	
	Least Mean Square Filters,	L29	**T1,R1**	
	Constrained Least	L30,L31	**T2,R1**	
	Interactive Restoration.	L32,L33	**T1**	
	No. of classes required:8			
UNIT IV				
IMAGE SEGMENTATION	Detection of Discontinuities,	L34	**T2,R1**	
	Edge Linking And Boundary Detection, thresholding,	L35,L36	**T1,R1**	
	Region Oriented Segmentation.	L37	**T1,R1**	
	Wave Propagation in Lossless and Conducting Media	L38	**T2,R1**	
	Morphological Image Processing: Dilation and Erosion:	L39	**T1,R1**	
	Dilation, Structuring Element Decomposition,	L40,L41	**T2,R1**	
	Erosion,	L42	**T1,R2**	
	Combining Dilation and Erosion,.	L43,L44	**T2,R1**	
	Opening and Closing	L45	**T1,R1**	
	, Hit or Miss All Transformation	L46,L47	**T2,R1**	
	Illustrative Problems	L48	**T1,R2**	
	No. of classes required:15			
UNIT V				
IMAGE	Redundancies and their Removal	L49	**T2,R2**	

COMPRESSION	Methods, Error Free Compression,			
	Lossy Compression,	L50	**T1,R2**	
	Lossy and Lossless Predictive Coding,	L51	**T1,R2**	
	Transform Based Compression,	L52,L53	**T1,R2**	
	JPEG 2000 Standards.	L54	**T1,R2**	
	Fidelity Criteria, Image Compression Models,	L55	**T2,R2**	
	Huffman and Arithmetic Coding,	L56,L57	**T1,R2**	
	No. of classes required:09			
	Total No. of Classes :57			

7. Session Execution Log:

S.NO	Units	No. of Lectures Taken	Covered/ Not Covered
1	Unit I	17	Covered
2	Unit II	8	Covered
3	Unit III	8	Covered
4	Unit IV	15	Covered
5	Unit V	9	Covered

8. Assignment Questions

DIGITAL IMAGE PROCESSING MID –I ASSIGNMENT-QUESTIONS
SET - I
1 a. Explain in detail about sampling and quantization? (CO1)

   b. What are advantages and disadvantages of the digital image processing? (CO1)

2. Discuss in detail about fundamental steps involved in image processing? (CO1)

3. Solve the given matrix using K-L transform? $\begin{bmatrix} 1 & 4 \\ 6 & -3 \end{bmatrix}$ (CO1)

4. Calculate histogram equalized value for the given matrix $\begin{bmatrix} 4 & 6 & 8 & 1 & 8 \\ 2 & 6 & 4 & 8 & 8 \\ 4 & 5 & 2 & 1 & 5 \\ 3 & 4 & 4 & 5 & 2 \\ 5 & 5 & 5 & 5 & 5 \end{bmatrix}$ (CO2)

5. a) Describe image smoothening and sharpening filters in spatial domain. (CO2)

   b) Express image smoothening and sharpening filters in frequency domain. (CO2)

SET –II
Define spatial and gray level resolution. Explain about isopreference curves
2 Write about Walsh transform and calculate the 2D walsh transform for the N=8?
3 What are the properties of Haar transform & Slant transform
4 Write the steps involved in frequency domain filtering

SET-III
   1.State convolution theorem for 1D
   2 Define histogram of a digital image. Explain how histogram is useful in
     image enhancement?
   3 Explain the Order-Statistic Filters
   4 Find the number of bits required to store a 256 X 256 image with 32 gray levels

DIGITAL IMAGE PROCESSING MID- II ASSIGNEMNT QUESTIONS

SET-I

•   Write about noise probability density functions for all noise models.

•   Discuss the process of image restoration by direct inverse filtering.

•   Explain about region based segmentation

•   Explain about region splitting and merging with example.

SET-II

Discuss the main steps in continuous wavelet transform.

Explain about lossless predictive coding.

Explain about lossy predictive coding .

Explain with the block diagram about transform coding system.

Compute Huffman coding for the following

Original source symbol

SET-III

- Explain about the image compression models?

- a) Write the differences between the image enhancement &image restoration?

- b) Write about noise probability density functions for all noise models?

- What is meant by the image segmentation and discuss the various types of the applications?

- Find the Huffman code for the following: P(A)=0.2, p(B)=0.1

- p(C)=0.2,p(D)=0.05,p(E)=0.3,p(F)=0.05,p(G)=0

9. Sample assignment script

(Attached Separately)

10. Unit-wise course material

(Attached Separately)

11.Mid exam question papers

MID-1

1. Explain Homomorphic Filtering In Detail? (C0-2)
2. a)What Is Histogram?(C0-2)
b)Perform The Histogram Equalization Of The Image [1 2 2 4]
3 1 1 5
1 6 7 3
3. a. Explain in detail about sampling and quantization? (CO1)
b. What are advantages and disadvantages of the digital image processing? (CO1)
4. Describe fundamental steps of Digital Image Processing With A Diagram? (C0-1)

MID – II

1.What is meant by image restoration? Express the concept of Image degradation model.

(CO3)

2. Explain in detail about (i) Inverse Filter (ii) Wiener Filter (CO3)

3. (a). Discuss in detail about the detection of discontinuities with suitable examples. (CO4)

(b). Explain the following morphological image processing (CO4)

(i). Opening and Closing (ii). Erosion and Dilation (iii) Hit and Miss Transformation

4. Demonstrate the Huffman coding with suitable example. (CO5)

12. SCHEME OF EVALUATION:

S.NO	Q.NO	THEORY	MARKS	TOTAL
1	1(a)	image restoration	2	
	1(b)	Image degradation model	3	5
2	2	INVERSE FILTER	2	
		WIENER FILTER	3	5
3	3(a)	DETECTION OF DISCONTINUITIES	3	
	(b)	MORPHOLOGICAL IMAGE PROCESSING	2	5
4	4	HUFFMAN CODING	5	5

13. SAMPLE MID ANSWER SCRIPT

(Attached Separately)

14. MATERIAL COLLECTED FROM INTERNET/WEBSITES

(Attached Separately)

15. POWER POINT PRESENTATIONS

(Attached Separately)

16.PREVIOUS QUESTION PAPERS

UNIT - I

1.What is meant by digital image processing? What are the applications of it? How an image is represented digitally?
b) Non uniform sampling is useful for what type of images. Give reasons. [5+5

3.a) Is fast algorithm applicable for computation of Hadamard transform, if so what are the problems encountered in implementation.
b) Explain Discrete Cosine Transform and specify its properties. [5+5]
4.a) What is a histogram of an image? Sketch histograms of basic image types.
b) Discuss how histogram is useful for image enhancement. [5+5

5. What are the techniques used for image smoothing? Explain any one spatial and one frequency techniques used for image smoothing. [10]
6. Describe constrained least square filtering technique for image restoration and derive its transfer function. [10]
7. Describe with mathematical model, both constrained and unconstrained restoration. [10]

UNIT – II

1.   Narrate the concept of derivative filters.

2.   Discuss how the derivative filters are used in Digital Image Enhancement?

3.   Describe Histogram Specification

1.   UNIT - III

1.   Narrate the concept of derivative filters.

2.   Discuss how the derivative filters are used in Digital Image Enhancement?

3.   Describe Histogram Specification

UNIT IV

1.   Compare image enhancement and restoration techniques?

2.   Give the probability density functions for Rayleigh noise models

3.   Give the probability density functions for the Erlang noise models

UNIT -V

1.   1 Write about edge detection

2.   Explain about the Local processing for edge linking

3.   Write short note on Region Growing

17.REFERENCES (TEXT BOOKS/WEBSITES/JOURNALS)

WEBSITES:
1. NPTEL VIDEO LECTURES:
https://nptel.ac.in/courses/117105135

2. COURSERA:

https://www.coursera.org/learn/digital

EXPERT DETAILS

The Expert Details which have been mentioned below are only a few of the eminent ones known Internationally, Nationally and Locally. There are a few others known as well.

INTERNATIONAL
Arokiaswami Alphones

Associate Professor

School of Electrical and Electronic Engineering

Nanyang Technological university

Singapore

E-mail – ealphones@ntu.edu.sg

Phone – (+65) 67904486, (+91) 9500195198.

NATIONAL
Dr. B. Manimegalai

Professor

Department of ECE

Thiagarajar College of Engineering

Madurai, Tamil Nadu

Email - naveenmegaa@tce.edu

Mobile - +91-9865191244

Dr. D. Sriram Kumar
Professor

Department of Electronics and Communication Engineering
National Institute of Technology Tiruchirappalli

India - 620015

E- mail – srk@nitt.edu

Mobile - +91-

Dr. T. Shanmuganantham

Associate Professor

School of engineering and technology

Pondicherry University

E- mail - shanmuga.dee@pondiuni.edu.in

Mobile +91 9486640168

INDUSTRY:

Dr. C. Gokulnath

Senior Research RF Engineer

HCL Technologies

Chennai

E-mail – gokul.kesav@gmail.com

Mobile - +91-9943092095

JOURNAL:

INTERNATIONAL

1. **Journal of IMAGE PROCESSING and applications -**
   https://www.tandfonline.com/toc/tewa20/current
2. **DIGITAL IMAGE PROCESSING**
   https://www.tandfonline.com/toc/uemg20/current
3. IEEE Transactions on IMAGE PROCESSING Compatibility
4. IEEE Transactions on IMAGE PROCESSING and Techniques