COURSE PLAN

A. COURSE OVERVIEW

Degree:	BE	Programme:	ISE
Academic Year:	2016-17	Semester:	7
Course Title:	**Digital Image Processing**	Course Code:	**10IS762**
L-T-P-S:	4-1-0-0	Duration of USE:	180 Minutes
Total Contact Hours:	52 Hrs	USE Marks:	100 Marks
IA Marks:	25	Assignment	1 / Unit
Lesson Plan Author:	Mr. Harivinod N	Sign	Dt : 15/06/2016
Checked By:	Mr. Mahesh Prasanna K	Sign	Dt : 15/06/2016

B. PREREQUISITES

- Engineering Mathematics-I (10MAT11)
- Engineering Mathematics-III (10MAT31)

C. COURSE DESCRIPTION

i) Course Outcomes

At the end of the course, the student will be able to;

1. Know the basics of fundamental steps in digital image processing and its applications
2. Perform image enhancement using pixel, frequency and morphological based techniques.
3. Apply boundary and region based segmentation to extract region of interest
4. Apply digital image processing techniques to solve real world problems

ii) Relevance of the Course

- Project work (10CS85)
- Seminar (10CS86)

iii) Applications areas

The digital image processing is applied in solving various problems in follows areas

- Agricultural (Fruit grading, harvest control, seeding, fruit picking)
- Communications (compression, video conferencing, television)
- Character recognition (printed and handwritten)
- Commercial (Bar code reading, bank cheques, signature)
- Document processing (Electronic circuits, mechanical drawings, music)
- Human (Heads and faces, hands, body)
- Industrial (Inspection, part pose estimation and recognition, control)
- Leisure and entertainment (museums, film industry, photography)
- Medical (X-rays, CT, NMR, ultrasound, intensity)
- Military (Tracking, detection, etc)
- Police (Fingerprints, surveillance, DNA analysis, biometry)
- Traffic and transport (Road, airport, seaport, license identification)

Prepared by: Harivinod N	Checked by: Mahesh Prasanna K	HOD

COURSE PLAN

D1. ARTICULATION MATRIX, CO v/s PO

Mapping of CO to PO												
	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1. Know the basics of fundamental steps in digital image processing and its applications	2	-	-	-	-	1	-	-	-	-	-	-
2. Perform image enhancement using pixel, frequency and morphological based techniques.	3	2	-	2	2	-	-	-	-	-	-	2
3. Apply boundary and region based segmentation to extract region of interest	3	2	1	2	2	-	-	-	-	-	-	2
4. Apply digital image processing techniques to solve real world problems	3	3	3	3	3	3	1	-	3	2	2	2

Note: Mappings in the Tables D1 (above) and D2 (below) are done by entering in the corresponding cell the Correllation Levels in terms of numbers. For Slight (Low): 1, Moderate (Medium): 2, Substantial (High): 3 and for no correllation: " - ".

D2. ARTICULATION MATRIX, CO v/s PSO

Mapping of CO to PSO			
	PSOs		
COs	1	2	3
1. Know the basics of fundamental steps in digital image processing and its applications	2	-	-
2. Perform image enhancement using pixel, frequency and morphological based techniques.	3	-	-
3. Apply boundary and region based segmentation to extract region of interest	3	-	-
4. Apply digital image processing techniques to solve real world problems	3	-	-

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E. UNIT PLANS

UNIT – I

Title:	**Digitized Image and its properties**	Appr. Time:	6 Hrs

UO:	Bloom's Level
At the end of the Unit, the student should be able to:	
1. Know the basic concepts of the digital image and its formation	L1
2. Understand the properties of digital image	L2
3. Understand the noise formation in the image	L2

Lesson Schedule:

Lecture No.	Portion to be Covered
1	Introduction to Digital Image Processing
2	Basic concepts
3	Image digitization- sampling and quantization
4	Color images
5	Digital image properties
6	Noise in images

Remarks:

Application Areas:

- Generating high and low resolution images
- Applicable in improving quality of image by removing noise

Review Questions (CO):

1	Briefly explain the process of image digitization. (CO1)
2	Explain visual perception of image (CO1)
3	Explain Euclidean distance and chessboard distance. (CO1)
4	Describe various noise models. (CO1)
5	Give an expression for the convolution of 2D functions f and h. What is the Fourier transform of g. (CO1)
6	Explain any two models of noise that can distort an image and two by which the quality of an image can be assessed. (CO1)
7	Define Image. Explain the steps involved in digital image processing with block diagram. (CO1)
8	Explain the low level processing concept in image processing (CO1)
9	Explain the fundamental steps of image processing. (CO1)
10	Write a note on metrics. (CO1)

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UNIT – II

Title:	**Image Preprocessing**	Appr. Time:	7 Hrs

UO:	Bloom's Level
At the end of the Unit, the student should be able to:	
1. Improve the quality of image using pixel transformations	L1
2. Understand the process of geometric transformation	L2
3. Apply Local preprocessing for image enhancement and extraction of edges.	L3

Lesson Schedule:

Lecture No.	Portion to be Covered
1	Introduction to Pre-processing
2	Pixel brightness transformations
3	Geometric transformations
4	Local Preprocessing
5	Image smoothing
6	Edge detectors, Canny edge detection
7	Adaptive neighbourhood pre-processing

Remarks:

Application Areas:

- Medical and industrial applications
- Improve the quality of images captured by cameras
- Edges can used as features for computer vision algorithms.

Review Questions (CO):

1	Briefly explain brightness interpolation. (CO1)
2	Explain three criterias used for development of Canny edge detection. (CO2)
3	Explain the steps involved in Canny edge detection. (CO2)
4	With an example of 3x3 operator, that approximates the first derivative and a 3x3 operator that approximates the second derivative, briefly explain how edges can be detected in an image, using derivatives. (CO2, CO4)
5	State the aim of histogram equalization. Also write an algorithm to perform histogram equalization. (CO2, CO4)
6	Explain the different stages in geometric transformation. (CO2)

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UNIT – III

Title:	**Segmentation-1**	Appr. Time:	7 Hrs

UO:	Bloom's Level
At the end of the Unit, the student should be able to:	
1. Know segmentation using image thresholding	L1
2. Apply edge based segmentation techniques	L3
3. To understand object detection using Hough transform	L2

Lesson Schedule:

Lecture No.	Portion to be Covered
1	Thresholding, Optimal Thresholding
2	Adaptive Thresholding
3	Threshold detection methods
4	Edge based segmentation
5	Edge relaxation
6	Border tracing
7	Hough transforms

Remarks:

Application Areas:

- Content based image retrieval, Video Surveillance
- Machine Vision, Medical imaging
- Object Detection, Traffic control systems

Review Questions (CO):

1	Discuss the concept of thresholding. Briefly explain optimal thresholding and multispectral thresholding algorithms. (C03)
2	What is basic thresholding? How it can be used to an image. Write an algorithm for iterative optimal thresholding. (CO3, CO4)
3	Describe the concept of border detetcion using border location information. (CO3)
4	Write an algorithm to trace the inner boundary and outer boundary of an image. (CO3)
5	Explain Image Segmentation.

UNIT – IV

Title:	**Segmentation-2**	Appr. Time:	6 Hrs

UO:	Bloom's Level
At the end of the Unit, the student should be able to:	
1. Apply region based segmentation	L3
2. Understand matching strategies for matching	L2
3. Understand control strategies for matching	L2

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Lesson Schedule:

Lecture No.	Portion to be Covered
1	Region based segmentation
2	Region splitting
3	Region merging
4	Region growing, post-processing
5	Matching criteria
6	Control strategies of matching

Remarks:

Application Areas:

- Content based image retrieval
- Machine Vision, Medical imaging
- Object Detection
- Traffic control systems, Video Surveillance

Review Questions (CO):

1	Explain briefly water shed segmentation. (CO3, CO4)
2	Briefly explain the basics of spatial filtering. (CO3)
3	Write an algorithm to segment an image using “Split and Merge” (CO3)
4	How can “matching” be used to search for specific patterns in the image. (CO3)
5	Define Region Merging. Write an algorithm for region merging via boundary melting(CO3)
6	With the help of algorithm explain split and merge algorithm.(CO3)

UNIT – V

Title:	**Image Enhancement**	Appr. Time:	7 Hrs

UO:	Bloom's Level
At the end of the Unit, the student should be able to:	
1. Apply image enhancement in the spatial domain	L3
2. To understand 2D Fourier transform	L2
3. Perform image enhancement in the frequency domain	L3

Lesson Schedule:

Lecture No.	Portion to be Covered
1	Some basic gray level transformations
2	Histogram processing
3	Smoothing and Sharpening spatial filters
4	Image enhancement in the frequency domain
5	Fourier transform and the frequency domain
6	Smoothing and sharpening Frequency-Domain filters
7	Homomorphic filtering

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Remarks:

Application Areas:
• Digital Camera • Image editing software • Image Segmentation • Any computer vision problem • Medical image processing

Review Questions (CO):	
1	Discuss homomorphic filtering in detail with a neat block diagram. (CO2, CO4)
2	Briefly explain the basics of spatial filtering. (CO2)
3	What is histogram matching (or specification)? Briefly explin how it can be implemented. (CO2, CO4)
4	What are the order statistics filters? How they can be used to enhance the image.(CO2)
5	Explain how ideal band pass and Butterrworth band pass filter is done for filtering (CO2)

UNIT – VI

Title:	**Image Compression**	Appr. Time:	6 Hrs
UO:			Bloom's Level
At the end of the Unit, the student should be able to:			
1. Know the importance of compression			L1
2. Understand image compression model			L2
3. Apply error-free image compression techniques			L3

Lesson Schedule:

Lecture No.	Portion to be Covered
1	Introduction to image compression
2	Image compression models,
3	Elements of information theory
4	Error-Free Compression
5	Lossy compression.

Remarks:

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Application Areas:
• Image transmission in networks, Video over network • Satellite imagery, FAX • Digital cameras • DVD technology • Storage and transmission of medical images

Review Questions (CO):	
1	Explain noiseless coding theorem. (CO1)
2	Explain in brief how elements of information theory can be used to represent the image. (CO1)
3	With a neat diagram explain the general compression model system. (CO4)
4	Suggest any two types of reducndancy in an image that can be exploited to achive a higher compression ratio. (CO1)
5	Explain briefly any two-error free coding techniques. (CO4)

UNIT – VII

Title:	**Shape Representation**	Appr. Time:	7 Hrs
UO:			Bloom's Level
At the end of the Unit, the student should be able to:			
1. Know different shape representation techniques used			L1
2. Apply shape representation techniques for matching			L3
3. Understand the importance of global descriptors			L2

Lesson Schedule:

Lecture No.	Portion to be Covered
1	Region identification,
2	Contour-based shape representation and description
3	Chain code, segment sequences
4	Region based shape representation and description
5	Moments
6	Graph based representations
7	Shape classes

Remarks:

Application Areas:
• Object detection • Object retrieval • Content based image retrieval

Review Questions (CO):

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1	Discuss in detail the different scalar region descriptors (CO4)
2	Explain region decomposion with neat diagram (CO3)
3	Explain region neighbourhood graphs (CO1)
4	Briefly explain any two border representation techniques (CO4)
5	Suggest an algorithm to identify the 4-neighborhood and 8-neighborhood of a region. (CO4)
6	What are shape classes? Suggest any approach to identify the shape class of an object in an image. (CO4)
7	Explain shape description methods. (CO3)
8	Write an algorithm for 4-neighborhood and 8-neighborhood region (CO3)

UNIT – VIII

Title:	**Morphology**	Appr. Time:	6 Hrs

UO:	Bloom's Level
At the end of the Unit, the student should be able to:	
1. Know the usage of mathematical morphology	L1
2. Apply morphology for binary image analysis	L3
3. Apply morphology for gray scale image analysis	L3

Lesson Schedule:

Lecture No.	Portion to be Covered
1	Basic morphological concepts
2	Opening and closing
3	Morphology principles
4	Binary dilation and erosion
5	Gray-scale dilation and erosion
6	Morphological segmentation and watersheds

Remarks:

Application Areas:

- Removing imperfections by accounting for the form and structure of the image

Review Questions (CO):

1	Discuss the concept of opening and closing (CO2)
2	Describe top hat transformation with a diagram (CO2,CO4)
3	Explain in detail, the four basic principles of morphology (CO2)
4	Briefly explain the operartion of binary dilation and erosion. Write an expression for “Closing” and “opening” interms of dilation and erosion. (CO2)
5	Briefly explain how erosion and dilation can be applied to a grayscale image (CO2)
6	Explain the concept of Binary Morphological Segmentation. (CO2)
7	Explain Hit and Miss transformation. (CO2)

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F. INTERNAL ASSESSMENT MODEL QUESTION PAPER (from Units 1 & 2)

Dept: CSE	Sem / Div: 7CS A&B	Sub: Digital Image Processing	S Code: 10CS762
Date: 03/09/2016	Time: 90 Min.	Max Marks: 40	Elective: Y

Note: Answer any 2 FULL questions, each carry equal marks.

QN		Questions	Marks	Bloom's Level	CO no.
1	a	Discuss fundamental stages of digital image processing.	8	L2	CO1
	b	Give different brightness interpolation techniques used in image transformation.	6	L1	CO1
	c	Briefly explain sampling and quantization.	6	L2	CO1
2	a	Describe Canny edge detection algorithm in detail.	8	L2	CO2
	b	Explain different noise models.	6	L2	CO2
	c	Apply 3x3 average filter and 3x3 median filter for the image whose pixel values are shown. Assume rows and columns are replicated at the border. 2 3 10 10 2 3 10 10 5 5 10 5 5 10 5 2	6	L3	CO2, CO4
3	a	Explain visual perception of image.	5	L2	CO1
	b	Briefly describe topological properties in digital images.	5	L2	CO1
	c	Write an algorithm to perform histogram equalization. Apply Histogram equalization for the image having following pixel values. 10 10 75 75 90 10 75 75 75 90 75 75 75 90 90 75 75 90 90 10 75 90 90 10 10	10	L3	CO2, CO4

G. INTERNAL ASSESSMENT EVALUATION

Evaluation	Weightage in Marks
IA Test – 1	25
IA Test – 2	25
IA Test – 3	25
Assignments	To deepen student's understanding and increase his/her confidence in the topics studied. Further, to improve the oral, written skills and engineering aptitudes.
Seminars	

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I. QUESTIONS APPEARED IN THE PREVIOUS YEARS

Course:		Digital Image Processing	Course Code:	10CS762
Unit	SNo	Questions		Appeared in year
I	1	With a neat block diagram describe the various phases of typical image processing system.		2007
	2	Define image. Explain the steps involved in image digitization.		2011
	3	Explain the basic steps in digital image processing, with a block diagram		2015
	4	Discuss the metric and topological properties of digital images		2007
	5	Discuss the procedure of sampling and quantization, with example		2015
	6	With an example, explain and write distance transform algorithm.		2011
	7	Define noise. Discuss types of noise. Write an algorithm for generation of additive zero mean Gaussian noise.		2011
II	1	Discuss any two piece wise linear transformation functions		2007
	2	Describe the procedure for histogram equalization. Illustrate with an suitable example considering a 3x3 image.		2007
	3	Define histogram equalization. Develop an algorithm for contrast enhancement using this technique.		2015
	4	Write a note on image enhancement using logical operators		2007
	5	Discuss any two image smoothing techniques in spatial domain.		2015
	6	Explain the steps involved in geometric transformation		2011
		Write an algorithm for image averaging using rotation mask using noise suppression.		2011
III	1	With an algorithm, describe the suitability of canny edge detector for Gaussian noisy images.		2007
	2	Explain any two threshold detection methods.		2007
	3	What are LOG and DOG? Describe the procedure of extracting edges using LOG edge detection technique.		2015
	4	Explain inner boundary and outer boundary tracing techniques.		2015
	5	Describe the procedure of detecting lines- using Hough transform		2015
	6	Discuss the procedure of obtaining the segmented regions using split and with example		2015
	7	Explain image segmentation by optimal thresholding method.		2011
	8	What are the properties to be preserved for segmentation? Describe an iterative optimal threshold detection technique.		2015
	9	Write an algorithm for curve detection using Hough Transform.		2011
	10	Explain border detection using dynamic programming.		2011
IV	1	Write a note on Watershed segmentation		2007
	2	What is region merging- write an algorithm for region merging via boundary melting.		2011
	3	Explain region based segmentation using quad tree method.		2011
	4	Define matching. Explain match based segmentation and its control strategies.		2011

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V	1	Show that the Fourier transforms and inverse are linear processes.	2007
	2	Prove that the Fourier transform has the translation property.	2007
	3	Explain the various types of gray level transformations.	2015
	4	Discuss briefly image sharpening techniques in frequency domain	2015
	5	Write a short note on Homomorphic filters	2015
		Explain image enhancement using i) Histogram equalization ii) Contrast Stretching	2011
	6	Explain image sharpening using spatial domain method	2011
	7	Explain low, high and band pass filtering with respect to frequency domain method.	2011
VI	1	With suitable example, discuss any two basic data redundancies that can be identified and exploited in digital images.	2007
		Define image compression. Explain types of redundancy.	2011
	2	Develop an algorithm for redundancy reduction using Huffman coding technique. Trace your algorithm with suitable example.	2007
	3	Define image compression. Describe the general image compression model with block diagram	2015
	4	Explain how Huffman coding technique helps in reducing the size of an irnage data. Obtain Huffman code for the following data. Also compute entropy and efficiency:	
	5	Write an algorithm for Huffman code and construct a code word for the word “COMMITTEE”	2011
	6	Discuss in brief transform coding technique with a neat block diagram.	
	7	With a neat diagram explain lossless predictive coding.	2011
VII	1	Discuss any two contour based shape representation techniques with an example.	2007
	2	What are the factors need to be considered for a robust shape representation? Discuss any two region based approaches which address these factors	2007
	3	Describe the procedure of region identification using 4-neighborhood and 8-neighborhood.	2011 2015
	4	Explain any three region a:rd contour based shape representation models.	2015
	5	Explain region based shape representation and description	2011
	6	Describe contour based shape representation with respect to i) Chain code ii) Border representation	2011
VIII	1	Define and erosion and dilation process. Explain the procedure for boundary extraction using morphological operators.	2007
	2	Describe the role of structuring element in mathematical morphology. Prove that dilation is commutative.	2007
	3	Write note on Morphological Segmentation	2007
	4	Define morphology. Discuss binary dilation and erosion in detail	2015

Date	a1	a2	a3	a4	a5	a6
Probability of occurrence	0.4	0.06	0.1	0.04	0.1	0.3

	5	Briefly explain the following morphological algorithms: Hit-or-miss transform, Region filling.	2015
	6	What is morphological operation. Explain following morphological operations. i) Dilation and Erosion ii) Opening and closing iii) Hit or Miss transformation	2011
	7	What do you mean by skeletanization? Explain sequential thinning by structural elements.	2011
	8	Explain morphological segmentation and watershed.	2011