INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**DIGITAL IMAGE PROCESSING**			
Course Code	**A70436**			
Class	**IV B.Tech I sem**			
Regulation	**R15 – JNTUH**			
Course Structure	**Lectures**	**Tutorials**	**Practical**	**Credits**
	4	**1**	**-**	**4**
Course Coordinator	**Dr. S. China Venkateswarlu, Professor, ECE**			
Team of Instructors	**Dr. V. Padmanabha Reddy, Professor, ECE**			

I. COURSE OVERVIEW

This course gives the students the fundamentals of digital image processing, linear filtering, linear transforms, image enhancement in both spatial and frequency domain;; image reconstruction; inverse problems in imaging; edge detection; feature extraction; compression; wavelet based imaging and mathematical morphology

II. PREREQUISITE(S)

Level	Credits	Periods/ Week	Prerequisites
UG	4	4	Signals and Systems

III. MARKS DISTRIBUTION

Sessional Marks (25 Marks)	University End Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective test and objective test. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each subject shall contain 4 questions; the student has to answer any 2 questions, each carrying 5 marks. The objective test is for 10 marks, with duration of 20 min. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are marked for assignments. There shall be two assignments in every theory course. First assignment marks will be allotted to 1st mid for first two and half units and second assignment marks will be allotted to 2nd mid for the remaining portion. So each mid exam is conducted for 25 marks.	75	100

IV. EVALUATION SCHEME

S. No	Component	Duration	Marks
1.	I Mid Examination	80 minutes	20
2.	I Assignment	-	5
3.	II Mid Examination	80 minutes	20
4.	II Assignment	-	5
5.	External Examination	3 hours	75

V. COURSE OBJECTIVES

At the end of the course, the students will be able to

I. Provide the student with fundamentals of digital image processing.
II. Build various Image enhancement, restoration and compression techniques
III. Develop various Image segmentation methods, Wavelet based and morphological Image Processing
IV. Give the student a taste of the applications of the theories taught in the subject. This will be achieved through the project and some selected lab sessions.
V. Introduce the students to some advanced topics in digital image processing.

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to

1. Explain the basic elements and applications of image processing
2. Analyze image sampling and quantization requirements and implications
3. Design and implement two-dimensional spatial and frequency filters for image enhancement
4. Model the image restoration problem in both time and frequency domains
5. Explain the image segmentation and image compression problem
6. Develop Wavelet based applications
7. Illustrate Morphological image processing.
8. Be able to implement basic image processing algorithms in MATLAB
9. Have the skill base to further explore advance of topics of digital image processing
10. Be in a position to make a positive professional contribution in the fields of digital image processing

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments
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.	H	Exercises
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.	N	-----
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.	N	-------
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.	S	Discussion, Seminars
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.	H	Design exercise, Prototypes
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.	H	Exercise, Seminars, Discussions

Program Outcomes		Level	Proficiency assessed by
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	----
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	N	-----
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.	S	Seminars, Discussions
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.	H	Workshops, Prototypes
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.	S	Seminar, Discussions

N - None **S - Supportive** **H - Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	S	Lectures, Assignments
PSO2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	H	Lectures, Assignments
PSO3	**Successful career and Entrepreneurship:** An understanding of social awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	S	Guest Lectures

N - None **S - Supportive** **H - Highly Related**

IX. SYLLABUS

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, Hoteling transform

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 operation, median filter processing. Spatial domain high pass filtering.

IMAGE ENHANCEMENT (FREQUENCY DOMAIN)
Filtering in frequency domain, obtaining frequency domain filters from spatial filters, Generating filters directly in the 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 square restoration, Interactive restoration

UNIT –IV IMAGE SEGMENTATION
Detection of discontinuities, Edge linking and boundary detection, Threshold, Region oriented segmentation Morphological Image Processing
Dilation and Erosion: Dilation, Structuring Element Decomposition, the Strel function, Erosion. Combining Dilation and Erosion: Opening and closing the hit and miss transformation

UNIT – V IMAGE COMPRESSION
Redundancies and their removal methods, Fidelity criteria, Image compression models, Source encoder and decoder, Error free compression, Lossy Compression, JPEG 2000 Standard

TEXT BOOKS:
1. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 3rd Editon, Pearson, 2008.
2. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, TMH, 2010.

REFERENCE BOOKS:
1. Digital Image Processing using MAT LAB, Rafael, C. Gonzalez, Richard E woods and Stens L Eddings, 2nd Edition, TMH, 2010
2. Fundamentals of Digital Image Processing, A.K. Jain, PHI, 1989
3. Digital Image Processing and Computer Vision, Somka, Hlavac, Boyle, Cengage Learning (India Edition) 2008
4. Introductory Computer vision Imaging Techniques and Solutions, Adrain Low, 2nd Edition, 2008
5. Introduction to Image Processing & Analysis – John C. Russ, J. Christian Russ, CRC Press, 2010
6. Wavelet Transforms (Introduction to theory and applications), Raghuveer M. Rao and Ajit S. Bopardikar, Pearson, 2000

X. COURSE PLAN

At the end of the course, the students are able to achieve the following course learning outcomes

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1-3	Outline what is an image and what is an digital image processing	Introduction to Image Processing	T1:1.1
4-5	Discuss various image fundamentals	Digital Image Fundamentals	T1:2.1
6-7	Illustrate sampling and quantization	Sampling and Quantization	T1:2.1
7-9	Relate relation between pixels	Relationship between pixels	T1:2.4
10-11	Explain 2d fft properties	2-D FFT, Properties	T1:2.1
12-13	Demonstrate various 2-D transforms	Walsh and Hadamard Transform, DCT, Haar transform, Slant transform, Hotelling Transform	T1:2.1
14	How to enhance image in spatial domain	Image Enhancement in Spatial Domain	T1:3.1
15-17	Classify enhancement processing techniques	Enhancement through point processing, Types of point processing	T1:3.2
18-20	Analyze histogram manipulation	Histogram Manipulation	T1:3.3
21-22	Demonstrate linear and non linear transforms	Linear and non-linear gray level transformation, local or neighbourhood operation	T1:3.3
23-26	Illustrate filtering in spatial domain	Median filter processing. Spatial	T1:3.3

		domain high pass filtering	
27-28	Illustrate filtering in frequency domain	Filtering in frequency domain, Obtaining frequency domain filters from spatial filters	T1:3.5
29-30	Determine filters	Generating filters directly in the frequency domain	T1:4.3
31-32	Illustrate LPF & HPF	Low pass (smoothing) and High pass (sharpening) filters in Frequency domain.	T1:4.3
33-35	Build degradation model	Degradation model, Algebraic approach to restoration, inverse filtering	T1:4.4
36-38	Model Least mean square filters	Least mean square filters. Constrained Least square restoration	T1:4.4
39	Model Interactive restoration	Interactive restoration	T1:5.5
40-42	Determine edges and boundary	Detection of discontinuities, Edge linking and boundary detection	T1:10.1
43-45	Design threshold models	Threshold	T1:10.3
46-47	Illustrate dilation	Dilation, Structuring Element Decomposition	T1:9.2
48-50	Illustrate erosion	the Strel function, Erosion	T1:9.4
51-52	Examine Dilation and erosion	Combining Dilation and Erosion: Opening and closing the hit and miss transformation	T1:9.4
53-55	Develop region segmentation	Region oriented Segmentation	T1:10.1
56-57	Classify various redundancies	Redundancies and their removal methods, Fidelity criteria	T1:10.4
58-59	Categorize compression models	Image compression models, Source encoder and decoder	T1:8.1
60	Model Error free compression	Error free compression	T1:8.4
61	Model lossy compression	Lossy Compression	T1:8.5
62	Summarize JPEG 2000 Standards	JPEG 2000 Standards	T1:8.6

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		H			S	H	H			S	H	S	S	S	S
2	H				S	S				S		H			
3		S				H	S				S		H		
4	H	H			S					S		H		S	S
5	H					S	H				S		S	H	

S – Supportive **H - Highly Related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	H			S	H	H			S	H	S	S	H	S
2						H									
3		H				S	H			S	H	S		S	
4	H				S						S		S		S
5		H				H	H			S		S		H	
6	H					S				S	H			S	
7	H				S		H						S		S
8		H				S				S		S		S	
9	H	H			S	H	H				S	S		H	
10	H				S					S	H		S		S

S – Supportive **H - Highly Related**

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