GUJARAT TECHNOLOGICAL UNIVERSITY

INSTRUMENTATION AND CONTROL (APPLIED INSTRUMENTATION) (03)

IMAGE PROCESSING FOR INSTRUMENTATION

SUBJECT CODE: 2730303

M.E. SEM-III

Type of course: Major Elective – IV

Prerequisite: None

Rationale: Digital images are everywhere these days – in thousands of scientific, consumer, and industrial applications. The ability to process image signal is therefore an incredibly important skill to master for engineering students, software developers, and practicing scientists. This course will introduce fundamental technologies for digital image representation, compression, analysis, and processing. Students will gain understanding of algorithm/system design, analytical tools, and practical implementations of various digital image applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

CourseContent:

Sr. No.	CourseContent	Teaching Hrs.	Module Weightage
1.	Introduction Digital image processing and its origin, Applications, Fundamental steps, Components.	2	0-10%
2.	Digital Image Fundamentals Elements of visual perception, Light and electromagnetic spectrum, Image sensing and acquisition, Image sampling and quantization, Basic relationship between pixels, Linear and nonlinear operations.	4	0-10%
3.	Intensity Transformations and Spatial Filtering Background, Some basic gray level transformations, Histogram processing, Enhancement using arithmetic/ logic operations, Basics of spatial filtering, Smoothing spatial filters, Sharpening spatial filters.	6	15-20%
4	Image enhancement in the Frequency Domain Background, Introduction to the Fourier transform and the frequency domain, Smoothing frequency domain filters, Sharpening frequency domain filters.	10	20-30%
5	Image compression and Wavelet Fundamentals, Image compression models, Error free coding: variable length, LZW, bit-plane, 2D-Wavelet transform fundamentals, Wavelet coding.	6	15-20%
6	Morphological Image Processing Preliminaries, Dilation and Erosion, Opening and closing, Hit-or-Miss transformation, Basic morphological algorithms, Extensions to Gray scale image.	6	15-25%

7	Image Segmentation Detection of discontinuities, Local processing, Global processing via Hough Transform, Thresholding: foundation, role of illumination, basic global and adaptive thresholding, Region based segmentation.	6	10-20%

Module weightage is given as a general guideline to students, actual weightage may vary.

ReferenceBooks:

(1) Digital Image Processing, by Rafael C. Gonzalez and Richard E. Woods, Pearson Education, Second Edition.
(2) Digital image processing using MATLAB, by Rafael C. Gonzalez Richard E. Wood and Steven L. Eddins, Pearson Education, Second Edition
(3) Fundamentals of Digital image processing, by Anil K.Jain. PHI
(4) Image Processing, Analysis, and Machine Vision, by MilanSonka, Vaclav Hlavac, and Roger Boyle, Cengage learning
(5) Digital image processing, by S. Jayaraman, S. Esakkirajan, T. Veerakumar, Tata McGraw-Hill publication
(6) Digital image processing, by S. Sridhar, Oxford University press

Course Outcome: After learning the course student will …

1. Learn to apply material by implementing and investigating image processing algorithms in MATLAB/ Scilab/ C/ C++.
2. Be able to conduct independent study and analysis of image processing problems and techniques.
3. Gain understanding of algorithm/system design, analytical tools, and practical implementations of various digital image applications.
4. Be able to develop the image processing tools from scratch, rather than using any image processing library functions.
5. Get broad exposure to and understanding of various applications of image processing in industry, medicine, and defense.
6. Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems.

Experiments (Using MATLAB/Scilab/C/C++):

During practical hours student has to prepare programs for various image processing algorithms covered in this course using any of the tools like (MATLAB, Scilab, C, C++).

Open Ended Problem: Student has to search and select (i) research paper from reputed conference or journal, or (ii) mini project, related to industrial application and has to implement the same using any tool/platform under the guidance of course instructor.

Major Equipments/Tools:

Computer Laboratory, MATLAB, Scilab, C, C++

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.