CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY (CHARUSAT
FACULTY OF TECHNOLOGY & ENGINEERING

DEVANG PATEL INSTITUTE OF ADVANCE TECHNOLOGY AND RESEARCH (DEPSTAR)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CS474: Image Processing and Computer Vision

Credits and Hours:

Teaching Scheme	Theory	Practical	rial	Total	Credit
Hours/week	4	2	_	6	5
Marks	100	50	_	150	

A. Objective of the Course:

This course introduces fundamental concepts and techniques for image processing and computer vision.

The objective of course are,

- To know the fundamental techniques for image processing, and computer vision.
- To introduce the student to computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving
- To use the C programming language or M-files in Matlab to implement computer vision algorithms.

B. Outline of the course

Sr. No.	Title of the unit	Minimum number of hours
1.	Digital Image Processing Fundamentals	04
2.	Segmentation of Grey level images	04
3.	Detection of edges and lines in 2D images	06
4.	Images Enhancement	07
5.	Introduction to Computer Vision	07
6.	Feature detection and matching	08
7.	Object Detection and Recognition	08
8.	Deep learning for Computer Vision	16

Total hours (Theory): 60
Total hours (Lab): 30
Total hours: 90

C. Detailed Syllabus:

1.	**Digital Image Processing Fundamentals**	**04 Hour**	**04 %**
	A simple image model, Sampling and Quantization, Imaging Geometry, Digital Geometry, Image Acquisition Systems, Different types of digital images		
2.	**Segmentation of Grey level images**	**04 Hour**	**07 %**
	Histogram of grey level images, Optimal thresholding using Bayesian classification, multilevel thresholding, Segmentation of grey level images, Water shade algorithm for segmenting grey level image.		
3.	**Detection of edges and lines in 2D images**	**06 Hours**	**07 %**
	First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking		
4.	**Images Enhancement**	**07 Hours**	**11 %**
	Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration.		
5.	**Introduction to Computer Vision**	**07 Hours**	**13 %**
	Introduction and Challenges in Computer Vision, Applications in real world, Geometric primitives, 2D and 3D transformations, Orthographic & Perspective Projection		
6.	**Feature detection and matching**	**08 Hours**	**15 %**
	Harris Corners, Invariant feature point detector -SIFT, SURF, RANSAC for point matching, Edge detection - LOG, DOG, Canny, Scale-Space Analysis - Image Pyramids and Gaussian derivative filter, Line, circle & ellipse detectors (Hough Transform)		
7.	**Object Detection and Recognition**	**08 Hours**	**16 %**
7.1	Machine Learning and Pattern Recognition in computer vision, classification models, Dimensionality Reduction (Principle component analysis), Face detection with sliding window – Haar-features, Viola Jones method and Adaboost training algorithm, People detection with sliding window, SVM, Bag of visual words		

8.	**Deep Learning for Computer Vision**	**16 Hours**	**27 %**
	Neural Networks Fundamentals, Past issues with deep networks, Convolutional Neural Networks (CNNs), training of CNNs, representation and transfer learning, CNNs in classification and recognition task.		

Course Outcome (CO)

CO1	Students will be able to understand the fundamentals of Image Processing
CO2	Students will learn different types of image segmentation techniques, edge detection and line detection
CO3	Students will be able to perform the image enhancement techniques
CO4	Students will be able to understand the basics of Computer Vision
CO5	Students will be able to perform feature detection, object detection and recognition
CO6	Students will be able to apply the Deep Learning techniques for different computer vision application

CO-PO Mapping
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	3	1	2	-	3	1	3	-	1	2	2	-	-
CO2	-	2	1	-	-	2	1	-	1	2	-	-	-	2	-
CO3	1	-	-	2	1	-	-	2	-	-	2	1	-	-	-
CO4	-	1	-	1	1	1	-	1	-	1	1	1	3	1	-
CO5	2	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO6	-	-	2	-	3	-	2	-	2	-	-	3	-	-	-

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory which carries a 5% component of the overall evaluation.
- Faculty deals with concept test as it implies focus on one key concept of learning

- Minimum two internal exams will be conducted and average of two will be considered as a part of 15% overall evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weightage of 5%.
- Surprise tests/Quizzes will be conducted which carries 5% component of the overall evaluation. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Minimum 10 experiments are suggested in the laboratory related to course content.

E. Student Learning Outcomes:

By taking this course, the students will be able

- To understand the image formation process
- To design and implement algorithms to perform image processing and feature extraction.
- To design and implement algorithms for image segmentation.
- To understand the basic techniques of computer vision.
- To design and build a real computer vision-based applications.

F. Recommended Study Material:

- **Text Books:**

1. Digital Image Processing, R.C. Gonzalez, R.E Woods, Pearson Education
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Prentice Hall

- **Reference Books:**

1. Digital Image Processing and Computer Vision, R. J. Schalkoff, John Wiley & Sons Australia
2. Computer Vision, L. Shapiro, G. Stockman, Prentice-Hall
3. Introductory Techniques for 3D Computer Vision, E. Trucco, A. Verri, Prentice Hall