COMPUTER VISION (Major Elective-II)

Semester II (Computer Engineering)

SUB CODE: MECE206-C

Teaching Scheme (Credits and Hours)

Teaching scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
04	00	02	06	05	3	70	30	20	30	150

LEARNING OBJECTIVES:

The objective of this course is

- How can computers understand the visual world of humans
- This course treats vision as a process of inference from noisy and uncertain data and emphasizes probabilistic, statistical, data-driven approaches.
- Topics include image processing; segmentation, grouping, and boundary detection; recognition and detection; motion estimation and structure from motion.
- This offering will emphasize the core vision task of recognition in particular. We will train and evaluate classifiers to recognize various visual phenomena.

OUTLINE OF THE COURSE:

Unit No	Topics
1	Introduction to computer vision
2	Image Formation and Filtering
3	Machine Learning Crash Course
4	Grouping and Fitting
5	Recognition
6	Multiple Views and Motion
7	Advanced Topics

Total hours (Theory): 60

Total hours (Practical): 30

Total hours: 90

DETAILED SYLLABUS

Sr. No	Topic	Lecture Hours	Weight age (%)
1	**Introduction to computer vision:** • Understanding vision definitions and basic	06	15
2	**Image Formation and Filtering:** • Cameras and optics • Light and color • Pixels and image filters • Thinking in frequency • Image pyramids and applications	12	15
3	**Machine Learning Crash Course:** • Machine learning: overview • Machine learning: clustering • Machine learning: classification	10	20
4	**Grouping and Fitting:** • Edge detection and line fitting w/ Hough transform • Robust fitting (Hough Transform) • Robust fitting (RANSAC and others) • Mixture of Gaussians and EM • Gestalt cues, MRFs, and graph cuts	10	20
5	**Recognition:** • Recognition Overview and History • Image features and bag of words models • Interest points: corners • Interest points and instance recognition • Large-scale instance recognition • Detection with sliding windows • Detection with sliding windows continued • Context and Spatial Layout	08	15
6	**Multiple Views and Motion:** • Feature Tracking • Optical Flow • Epipolar Geometry • Stereo Correspondence • Structure from Motion	08	10
7	**Advanced Topics:** • Activity Recognition , Crowd sourcing • Internet Scale Vision, Attributes and Course Summary	06	05

INSTRUCTIONAL METHOD AND PEDAGOGY (Continuous Internal Assessment (CIA) Scheme)

- 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 lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.
- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

STUDENTS LEARNING OUTCOMES:

On successful completion of the course, the student will:

- When a 3-dimensional world is projected onto a 2-dimensional image, such as the human retina or a photograph, reconstructing back the layout and contents of the real-world becomes an ill-posed problem that is extremely difficult to solve. Understand how can an computer understand it.

- Humans possess the remarkable ability to navigate and understand the visual world by solving the inversion problem going from 2D to 3D. Computer Vision, a modern discipline of artificial intelligence, seeks to imitate such abilities of humans to recognize objects, navigate scenes, reconstruct layouts, and understand the geometric space and semantic meaning of the visual world.

- Vision understanding abilities are critical in many applications including personal robotics, autonomous driving and exploration as well as photo organization, image or video retrieval and human-computer interaction.

- This course delivers a systematic overview of computer vision, comparable to an advanced graduate level class.

- We emphasize on two key issues in modeling vision: space and meaning.

REFERENCE BOOKS:

1. "Computer Vision: Algorithms and Applications" by Richard Szeliski
2. Procedural Elements-Computer Graphics, David Rogers, TMH
3. Principals of Computer graphics, Shalini Govil-pal, springer

LIST OF PRACTICALS

Sr. No.	**Name of Experiment**
1	Hybrid images with Laplacian pyramids
2	pB Lite: boundary detection
3	Scene recognition with bag of words
4	Face detection with a sliding window
5	Tracking and Structure from Motion