Devi Ahilya University, Indore, India Institute of Engineering & Technology				**IVYear B.E. (Computer Engg.) (Full Time)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
CER7E4 Computer Vision	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Learning Objectives:

1. Be familiar with both the theoretical and practical aspects of computing with images;
2. Have described the foundation of image formation, measurement, and analysis;
3. Have implemented common methods for robust image matching and alignment;
4. Understand the geometric relationships between 2D images and the 3D world;
5. Have gained exposure to object and scene recognition and categorization from images;

Pre-requisites:

No prior experience with computer vision is assumed. However, the following skills are necessary for this class:

1. Math: Linear algebra, vector calculus, and probability.
2. Data structures: students are required to write code that represents images as feature and geometric constructions.
3. Programming: Basic knowledge of C++/Java/Python is helpful.

COURSE OF CONTENTS

Unit-I

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Unit-II

Depth estimation and Feature Extraction: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Unit-III

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Unit-IV

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Unit-V

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation. Light at Surfaces; Phong Model; Reflectance Map etc.

RECOMMENDED BOOKS

[1] Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
[2] Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
[3] Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
[4] K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
[5] R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

Learning Outcomes:

Upon Completing the Course, students will have knowledge of basics of computer vision and would be able to analyze the computer vision problems available in the real-world.

List of Assignment in Computer Vision Lab:

- Face Recognition using Face images available
- Image Captioning
- Video Event Categorization
- Video Analytics : Prediction, text para-phrasing
- Scene Ontology from arbitrary stereo