Code CSE3010	Computer Vision	Course Type	LP
		Credits	3

Course Objectives:

- Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision
- Describe the foundation of image formation and image analysis. Understand the basics of 3D Computer Vision.
- Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images.
- Get an exposure to advanced concepts leading to object and scene categorization from images.
- Build computer vision applications.

Course Outcomes:

At the end of the course, students should able to

- To implement fundamental image processing techniques required for computer vision.
- Understand Image formation process and generate 3D model from images.
- Extract features form Images and do analysis of Images.
- To develop applications using computer vision techniques.
- Understand video processing, motion computation and 3D vision and geometry.

Student Outcomes (SO): a, b, c, l

a. An ability to apply the knowledge of mathematics, science and computing appropriate to the discipline.

b. An ability to analyze a problem, identify and define the computing requirements appropriate to its solution.

c. An ability to design, implement and evaluate a system / computer-based system, process, component or program to meet desired needs.

l. An ability to apply mathematical foundations, algorithmic principles and computer science theory in the modelling and design of computer-based systems (CS).

Module No.	Module Description	No.of Hours	SO
1	**Digital Image Formation And Low Level Processing:** Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.	5	a, b, c
2	**Depth Estimation And Multi-Camera Views:** Depth Estimation and Multi-Camera Views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. apparel.	6	a, b, c
3	**Feature Extraction And Image Segmentation:** Feature Extraction: 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. **Image Segmentation:** Region Growing,	7	a,b, c

	Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.		
4	**Pattern Analysis And Motion Analysis:** 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. Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.	7	a,b,c
5	**Shape From X:** Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.	5	a, b, c
5	**Guest Lecture on Contemporary Topics**	**2**	
	Total Hours:	**30**	

Mode of Teaching and Learning: *Flipped Class Room, Activity Based Teaching/Learning, Digital/Computer based models, wherever possible to augment lecture for practice/tutorial and minimum 2 hours lectures by industry experts on contemporary topics*

Mode of Evaluation and assessment:

The assessment and evaluation components may consist of unannounced open book examinations, quizzes, student's portfolio generation and assessment, and any other innovative assessment practices followed by faculty, in addition to the Continuous Assessment Tests and Term End Examinations.

Text Book(s):

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.

Reference Book(s):

1.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2.	K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3	R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

Indicative List of Experiments

No.	Description of Experiment	SO
1	Implement image preprocessing and Edge detection	**l**
2	Implement camera calibration methods	**l**
3	Implement Projection	**l**
4	Determine depth map from Stereo pair	**l**
5	Construct 3D model from Stereo pair	**l**
6	Implement Segmentation methods	**l**
7	Construct 3D model from defocus image	**l**
8	Construct 3D model from Images	**l**
9	Implement optical flow method	**l**

10	Implement object detection and tracking from video	**l**
11	Face detection and Recognition	**l**
12	Object detection from dynamic Background for Surveillance	**l**
13	Content based video retrieval	**l**
14	Construct 3D model from single image	**l**

Recommendation by the Board of Studies on	**17.01.2020**
Approval by Academic council on	**20.01.2020**
Compiled by	**Dr. Soundarrajan**