INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

COMPUTER VISION								
VIII Semester: CSE(DS)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACDC21	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisites: Probability and Statistics, Probabilistic Modeling and Reasoning								

I. COURSE OVERVIEW:

This course provides an introduction to computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding. It also provides methods for depth recovery from stereo images, camera calibration, automated alignment, tracking, boundary detection, and recognition. We'll use both classical machine learning and deep learning to approach these problems. The focus of the course is to develop the intuitions and mathematics of the methods in lecture, and then to learn about the difference between theory and practice in the projects.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The theoretical and practical aspects of computing with images and connect issues from computer vision to human vision.
II. The foundations of shape and region analysis and understand the basics of 2D and 3D computer vision.
III. The Hough Transform and its applications to detect lines, circles, ellipses.
IV. The applications related to computer vision algorithms.

III. COURSE SYLLABUS:

MODULE – I: IMAGE PROCESSING FOUNDATIONS (09)

Review of image processing techniques, classical filtering operations, thresholding techniques, edge detection techniques, corner and interest point detection, mathematical morphology, texture.

MODULE – II: SHAPES AND REGIONS (09)

Binary shape analysis, connectedness, object labeling and counting, size filtering, distance functions, skeletons and thinning, deformable shape analysis, boundary tracking procedures, active contours, shape models and shape recognition, centroidal profiles, handling occlusion, boundary length measures, boundary descriptors, chain codes, Fourier descriptors, region descriptors, moments.

MODULE – III: HOUGH TRANSFORM (09)

Line detection, Hough Transform (HT) for line detection, foot-of-normal method, line localization, line fitting, RANSAC for straight line detection, HT based circular object detection, accurate center location, speed problem, ellipse detection

Case study: Human Iris location, hole detection, generalized Hough Transform (GHT), spatial matched filtering, GHT for ellipse detection, object location, GHT for feature collation.

MODULE - IV : 3D VISION AND MOTION (09)

Methods for 3D vision, projection schemes, shape from shading, photometric stereo, shape from texture, shape from focus, active range finding, surface representations, point-based representation, volumetric representations, 3D object recognition, 3D reconstruction, introduction to motion, triangulation, bundle adjustment, translational alignment, parametric motion, spline-based motion, optical flow, layered motion.

MODULE – V: APPLICATIONS (09)

Application: Photo album, Face detection, Face recognition, Eigen faces, Active appearance and 3D shape

models of faces, foreground background separation, particle filters, Chamfer matching, tracking, and occlusion, combining views from multiple cameras, human gait analysis.

IV. TEXT BOOKS:

1. Daniel Lelis Baggio, Shervin Emami, David Millan Escriva,"Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
2. E. R. Davies, "Computer & Machine Vision – Theory, Algorithms, Practicalities", Academic Press, 4th Edition, 2012.

V. REFERENCE BOOKS:

1. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.
2. Mark Nixon, Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", 3rd edition, Academic Press, 2012.
3. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
4. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

VI. WEB REFERENCES:

1. https://faculty.ucmerced.edu/mcarreira-perpinan/teaching/ee589/lecture-notes.pdf
2. https://patrec.cs.tu-dortmund.de/lectures/SS12/computervision/computervision.pdf
3. http://csundergrad.science.uoit.ca/courses/cv-notes/
4. http://www.cs.cmu.edu/afs/cs/academic/class/15385-s06/lectures/ppts/