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

COURSE CONTENT

COMPUTER VISION								
V Semester: CSE(CS)								
Course Code	**Category**	**Hours/Week**			**Credits**	**MaximumMarks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACCD05	**Elective**	3	0	0	3	40	60	100
Contact Classes:48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**TotalClasses:48**		
Prerequisites: There are no pre requisites to take this course								

I. COURSE OVERVIEW:

This course introduces 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.

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 Applications related to computer vision algorithms and network virtualization for handling big data.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1 Understand and apply key image processing techniques

CO2 Develop skills in binary shape analysis, object labeling, counting, and filtering based on size and other attributes.

CO3 Apply advanced techniques such as RANSAC for robust line fitting and solve problems related to efficient object localization and feature collation in both 2D and 3D contexts.

CO4 Apply techniques to real-world applications such as face detection and recognition, human gait analysis, multi-camera fusion, and occlusion handling.

CO5 Understand and implement algorithms for background subtraction, tracking, and combining views from multiple cameras to solve practical computer vision problems.

CO6 Design and Train Machine Learning Models for Vision Tasks

IV. COURSE CONTENT:

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 (10)

Binary shape analysis, connectedness, object labelling 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 (10)

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 (10)

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

V. TEXTBOOKS:

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

VI. REFERENCEBOOKS:

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

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VII. ELECTRONIC RESOURCES:

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/

VIII. MATERIAL ONLINE:

1. Course template
2. Tutorial question bank
3. Tech-talk topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. PowerPoint presentation
11. E-Learning Readiness Videos (ELRV)