INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**BACHELOR OF TECHNOLOGY (COMPUTER ENGINEERING)**
SEMESTER	**6**
COURSE TITLE	**COMPUTER VISION**
COURSE CODE	**01CE0612**
COURSE CREDITS	**3**

Objective:

1 The Computer Vision course provides students with fundamental knowledge and applied skills in the areas of image processing, feature extraction, object detection, tracking, and deep learning. It encourages the use of computer vision techniques to resolve practical issues while putting an emphasis on moral and responsible AI practises in a developing discipline.

Course Outcomes: After completion of this course, student will be able to:

1 Able to understand the basic concepts and applications of computer vision
2 Able to apply various image processing techniques to enhance and manipulate images.
3 Able to identify and extract features from images and perform feature matching.
4 Able to implement object detection and tracking algorithms.
5 Able to apply deep learning techniques for various computer vision tasks.

Pre-requisite of course: Prerequisites for the Computer Vision course include a solid background in linear algebra, calculus, probability and statistics, and proficiency in programming, particularly in Python.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to Computer Vision** Introduction to Computer Vision, History and Evolution of Computer Vision, Applications of Computer Vision in Various Fields, Human Vision vs, Computer Vision, Digital Image Representation and Basics of Pixel Operations, Color Spaces and Color Image Processing, Image Formation and Imaging Geometry	4

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Contents : Unit	Topics	Contact Hours
2	**Image Processing and Enhancement** Digital Image Fundamentals,, Image Enhancement Techniques (Histogram Equalization, Contrast Stretching, etc.), Image Filtering (Spatial Filters), Noise Reduction Techniques (Smoothing Filters), Image Sharpening (Laplacian and Gradient-Based Techniques)	8
3	**Feature Extraction and Matching** Feature Detection and Description, Harris Corner Detection, Scale Invariant Feature Transform (SIFT), Speeded-Up Robust Features (SURF), Feature Matching Algorithms (e.g., Brute-Force, FLANN), RANSAC for Robust Estimation, Applications of Feature Matching (e.g., Image Stitching)	7
4	**Object Detection and Tracking** Introduction to Object Detection, Sliding Window Approach for Object Detection, Haar Cascades for Face and Object Detection,, Histogram of Oriented Gradients (HOG) for Object Detection,, Object Tracking and its Challenges, Kalman Filters for Object Tracking, Multiple Object Tracking (MOT) and Tracking-by Detection	6
5	**Deep Learning for Computer Vision** Introduction to Deep Learning, Convolutional Neural Networks (CNNs) for Image, Object Recognition and Localization using CNNs Semantic Segmentation with Deep Learning, Object Detection with Region-Based CNNs (RCNN, Fast-RCNN, Faster-RCNN)	6
Total Hours		**31**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Practice 1** Apply histogram equalization and filtering techniques.	2
2	**Practice 2** Convert a color image into various color spaces.	2
3	**Practice 3** Implement feature detection algorithm	2
4	**Practice 4** Apply edge detection, smoothing, and sharpening techniques	2
5	**Practice 5** Apply image segmentation techniques.	2
6	**Practice 6** Implement feature matching algorithms.	2
7	**Practice 7** Apply object detection in images or video streams.	2
8	**Practice 8** Implement object tracking Algorithm in video sequences.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
9	**Practice 9** Build a CNN model using a deep learning framework for image classification.	2
10	**Practice 10** Fine-tune a pre-trained CNN model on a new dataset for image classification.	2
11	**Practice 11** Implement an object recognition system using deep learning techniques.	2
12	**Practice 12** Use deep learning models to perform image segmentation tasks.	2
13	**Practice 13** Develop a facial recognition system using any techniques.	2
14	**Practice 14** Final Project	2
Total Hours		**28**

Textbook :

1 "Computer Vision: Algorithms and Applications", Richard Szeliski, 2nd Edition, Springer International Publishing, 2022

References:

1 "Digital Image Processing", "Digital Image Processing", González and Woods, Pearson, 2002

2 "Computer Vision: A Modern Approach" , "Computer Vision: A Modern Approach" , David A. Forsyth and Jean Ponce , "Computer Vision: A Modern Approach" , 2015

3 "Deep Learning for Computer Vision", "Deep Learning for Computer Vision", Rajalingappaa Shanmugamani, Rajalingappaa Shanmugamani, 2018

4 "Computer Vision: Principles, Algorithms, Applications, Learning" , "Computer Vision: Principles, Algorithms, Applications, Learning" , E. R. Davies, Academic Press, 2017

5 "Computer Vision: A Reference Guide", "Computer Vision: A Reference Guide", David Vernon, Springer, 2014

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation

Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking
20.00	20.00	20.00	15.00	15.00	10.00

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Instructional Method:

1. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
4. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.