**Course Code: 22UPCSC1E19 / 22UPCSC2E19**          **Credits: 4**

## Computer Vision

**Course Objectives:**
- To get understanding about Computer vision techniques behind a wide variety of real- world applications.
- To get familiar with various Computer Vision fundamental algorithms and how to implement and apply.
- To get an idea of how to build a computer vision application with Python language.
- To understand various machine learning techniques that are used in computer vision tasks.
- To incorporate machine learning techniques with computer vision systems.

### Unit-I
**Basic Image Handling and Processing:** PIL – the Python Imaging Library-Matplotlib-NumPy-SciPy-Advanced example: Image de-noising. **Local Image Descriptors:** Harris corner detector-SIFT - Scale-Invariant Feature Transform-Matching Geotagged Images.

### Unit-II
**Image to Image Mappings:** Homographies-Warping images-Creating Panoramas. **Camera Models and Augmented Reality:** The Pin-hole Camera Model-Camera Calibration-Pose Estimation from Planes and Markers-Augmented Reality.

### Unit-III
**Multiple View Geometry:** Epipolar Geometry-Computing with Cameras and 3D Structure-Multiple View Reconstruction-Stereo Images. **Clustering Images:** K-means Clustering-Hierarchical Clustering-Spectral Clustering.

### Unit-IV
**Searching Images:** Content based Image Retrieval-Visual Words-Indexing Images- Searching the Database for Images-Ranking Results using Geometry-Building Demos and Web Applications. **Classifying Image Content:** K-Nearest Neighbors-Bayes Classifier-Support Vector Machines-Optical Character Recognition.

### Unit-V
**Image Segmentation:** Graph Cuts-Segmentation using Clustering-Variational Methods. **OpenCV:** Python Interface-OpenCV Basics-Processing Video-Tracking.

**Course Outcome:**

On the successful completion of the course, students will be able to,

| CO1 | To understand and recall computer vision and its application areas | |
|------|----------------------------------------------------------------|--------|
| CO2 | To develop build a computer vision system | |
| CO3 | To apply and analyze a design range of algorithms for image processing and computer vision | K1-K6 |
| CO4 | To develop incorporate machine learning techniques with computer vision system | |
| CO5 | To apply and analyze image segmentation and image registration | |

**K1- Remember,  K2 -  Understand,  K3 - Apply ,  K4 - Analyze,  K5 - Evaluate,  K6 -Create**

**Mapping with Programme Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | S | L | M | L | L | L | M | M | M | S | S | L |
| CO2 | S | M | L | M | M | L | S | L | S | L | S | L |
| CO3 | S | S | S | M | M | L | M | L | M | L | M | L |
| CO4 | S | S | S | M | M | L | M | L | M | L | S | L |
| CO5 | S | S | S | M | M | L | S | L | S | L | S | L |

**L - Low,  M- Medium, S - Strong**

**Course Code:  22UPCSC1E20 /22UPCSC2E20            Credits: 2**

**Computer Vision Lab**

**Course Objectives:**

- To get an idea of how to build a computer vision application with Python language.

- To learn the basic image handling and processing

- To get familiar with various Computer Vision fundamental algorithms and how to implement and apply.

- To get an idea of how to implement the image transforms.

- To understand various image segmentation algorithms.

Implement the following problems using Python with OpenCV

1.  Image Loading, Exploring, and displaying an Image.
2.  Access and Manipulate of Image Pixels.
3.  Image Transformations.
    - i)   Resizing
    - ii)  Rotation
4.  Addition operation of Two Images.

5.  Image filtering operations
    - i)   Mean Filtering
    - ii)  Gaussian Filtering

6.  Image Binarization Using Simple Thresholding method.

7.  Edge Detection operation using Sobel and Scharr Gradients.

8.  Find Grayscale and RGB Histograms of an Image.

9.  Segment an Image using K-means Clustering algorithm.

10. Write a program to classify an Image using KNN Classification algorithm.

**Course Outcome:**

On the successful completion of the course, students will be able to,

| CO1 | To develop and implement the image loading and exploring | |
|------|------------------------------------------------------------|--------|
| CO2 | To Evaluate the image transforms | |
| CO3 | To apply and analyze for image processing denoising algorithms | K1-K6 |
| CO4 | To design and develop the Image Segmentation using Edge | |
| CO5 | To apply and analyze image clustering and classification algorithms | |

**K1- Remember, K2 - Understand, K3 - Apply , K4 - Analyze, K5 - Evaluate, K6 -Create**

**Mapping with Programme Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | S | L | M | L | L | L | M | M | M | S | S | L |
| CO2 | S | M | L | M | M | L | S | L | S | L | S | L |
| CO3 | S | S | S | M | M | L | M | L | M | L | M | L |
| CO4 | S | S | S | M | M | L | M | L | M | L | S | L |
| CO5 | S | S | S | M | M | L | S | L | S | L | S | L |

L - Low, M- Medium, S - Strong