 **CVV/ Computer Science 2023**

| **Course Code** | **Course Name** | **L** | **T** | **P** | **C** |
| --- | --- | --- | --- | --- | --- |
|  | **IMAGE PROCESSING** | **3** | **0** | **0** | **3** |

This course gives an introduction to the concepts and applications of image processing and computer vision. This course teaches the fundamental techniques for image processing tasks such as image restoration, segmentation and compression. Computer Vision is a field that spans multiple disciplines and draws links to several traditional fields such as image processing, optics, probability, and statistics. After introducing image processing techniques, vision tasks such as shape reconstruction, object and scene recognition etc. are taught.

**Course Content:**

### Module 1: Fundamentals of Image Processing

### Visual perception, understanding how images are sampled and quantized, techniques for intensity transformations, exploring nonlinear transformations for image enhancement, methods of histogram equalization for better image contrast.

### Module 2: Image Restoration and Filtering

### Techniques for image restoration using spatial filters, applying the Wiener filter for noise reduction and image clarity.

### Module 3: Colour Spaces and Colour Image Processing

### Introduction to different colour spaces such as RGB, HSV, and YUV, methods and applications of colour image processing for various purposes.

### Module 4: Morphological Image Processing

### Principles of morphological operations including erosion and dilation, advanced techniques like opening and closing, understanding the hit-or-miss transform, methods for thinning and shape decomposition to analyze image structures.

### Module 5: Advanced Image Processing and Vision Techniques

### Techniques for image segmentation including edge detection, thresholding, and region-based segmentation, fundamentals of image compression covering lossless coding, predictive coding, and transform coding, comprehensive understanding of vision systems including cameras and projection models, methods for clustering, techniques for shape reconstruction from stereo images, principles of object recognition, scene recognition, face detection, and human motion categorization.

**Text Books:**

1. Gonzales R. C. and Woods R. E., Digital Image Processing, Prentice-Hall, 4 ed, 2018

2. Computer Vision: Algorithms and Applications, by Richard Szeliski, Springer, 2010.

3. Learning OpenCV, by Gary Bradski & Adrian Kaehler, O'Reilly Media, 2008.

References:

1. Multiple View Geometry in Computer Vision, 2nd Edition, by R. Hartley, and A. Zisserman, Cambridge University Press, 2004.

2. Computer Vision: A Modern Approach, by D.A. Forsyth and J. Ponce, Prentice Hall, 2002.

3. Pattern Classification (2nd Edition), by R.O. Duda, P.E. Hart, and D.G. Stork, WileyInterscience, 2000. 4. Pratt W. K., Digital Image Processing,

4 ed, Wiley, 2007 5. Bovik, A. C., The essential guide to image processing, Academic Press, 2009

6. Forsyth D. A. and Ponce J., Computer Vision - A Modern Approach, 2 ed, 2012.

7. M Sonka, V Hlavac, and R Boyle: Image Processing, Analysis, and Machine Vision, Thomson, Toronto, 4 ed, 2015.

**Course Outcomes: At the end of the course, a student will be able to:**

**•** Understand the fundamentals of image processing such as sampling and quantization

• Process image datasets in tools such as OpenCV and perform key image processing tasks such as transformations, restoration, segment and compression

• Learn the algorithms and techniques used in image processing

• Understand the fundamentals of computer vision such as Cameras and projection models

• Process image and video datasets in tools such as OpenCV and perform key computer vision tasks such as clustering; shape reconstruction from stereo, object recognition, scene recognition, face detection and human motion categorization.

• Implement the algorithms and techniques used in computer vision.