# FACULTY OF ENGINEERING & TECHNOLOGY

## Effective from Academic Batch: 2020-21

**Programme:** **Bachelor of Engineering (Information Technology)**

**Semester:** **VI**

**Course Code:** **102046705**

**Course Title:** **Computer Vision and Image Processing**

**Course Group:** **Professional Elective Course - II**

**Course Objectives:** This subject emphasis on fundamentals of Image processing and Computer vision. Students will gain the knowledge of Image Formation, Image Enhancement and Segmentation. Students will also learn various feature extraction techniques. This subject has more emphasis on core vision tasks through Motion estimation and Object as well as pattern recognition. Students shall explore the areas where automation can be possible through Image processing and Computer Vision.

**Teaching & Examination Scheme:**

| Contact hours per week | | | Course Credits | Examination Marks (Maximum / Passing) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | J/V/P* | | Total |
| Lecture | Tutorial | Practical | | Internal | External | Internal | External | |
| 3 | 0 | 2 | 4 | 40 / 14 | 60 / 21 | 20 / 7 | 30 / 10 | 150 / 52 |

* **J**: Jury; **V**: Viva; **P**: Practical

**Detailed Syllabus:**

| Sr. | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Digital Image fundamentals, Image Sensing and acquisition, Sampling and Quantization, Image formation models, Overview of Computer Vision, Applications of Image processing and Computer Vision | 04 |
| 2 | **Image Enhancement:** Image enhancement in spatial domain, Basic grey level Transformations, Histogram Processing Techniques, Spatial Filtering, Image smoothing and Image Sharpening, Image enhancement process in frequency domain, Low pass filtering, High pass filtering | 10 |
| 3 | **Image Segmentation:** point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection | 05 |

| | | |
|---|---|---|
| **4** | **Feature Extraction:**<br>Importance of Features, Feature extraction techniques, Histogram of Oriented Gradient (HOG), Scale Invariant Feature Transform (SIFT), Background subtraction techniques, Image Matching, Principal Component Analysis (PCA) | **08** |
| **5** | **Object Recognition and Motion Estimation:**<br>Object Recognition techniques: Viola-Jones, Yolo, Deep learning algorithms for Object Recognition. Optical Flow, Gaussian Mixture Model (GMM), Structure of Motion, Motion Estimation. | **10** |
| **6** | **Applications of Image Processing and Computer vision:**<br>Face Recognition, Facial Expression Recognition, Optical Character Recognition, Automated Video Surveillance | **04** |
| | Total | **41** |

**List of Practicals / Tutorials:**

| | |
|---|---|
| **1** | Implement various grey level transformations for Image Enhancement. |
| **2** | Implement Histogram Equalization technique. |
| **3** | Write a Program to apply convolution processes on an input image for image smoothing. |
| **4** | Implement Histogram of Oriented Gradient (HOG) for Feature extraction. |
| **5** | Write a Program to apply Scale Invariant Feature Transform on input image. |
| **6** | Implement frame differencing technique for background subtraction from video. |
| **7** | Implement Principal Component Analysis for the computation of Eigenvector to reduce the dimensionality. |
| **8** | Implement object detection algorithm YOLO. |
| **9** | Implement R-CNN algorithms for object detection. |
| **10** | Implement motion estimation using optical flow technique. |
| **11** | Implement Object recognition. |
| **12** | Implement Facial Expression Recognition. |

**Reference Books:**

| | |
|---|---|
| **1** | Digital Image Processing- Refael C. Gonzalez and Richard E. Woods, Wesley |
| **2** | Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill. |
| **3** | Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall. |
| **4** | Computer Vision, D. H. Ballard, C. M. Brown, Prentice-Hall, Englewood Cliffs, 1982. |

| **Supplementary learning material:** | |
|---|---|
| **1** | NPTEL Courses:<br>https://onlinecourses.nptel.ac.in/noc19_cs58/preview<br>https://onlinecourses.nptel.ac.in/noc19_ee55/preview |
| **2** | Coursera Courses on Image Processing, Computer Vision |

**Pedagogy:**

- Direct classroom teaching

- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

| Distribution of Theory Marks in % | | | | | | **R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating |
|---|---|---|---|---|---|---|
| **R** | **U** | **A** | **N** | **E** | **C** | |
| 15% | 25% | 25% | 15% | 15% | 05% | |

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes (CO):**

| Sr. | Course Outcome Statements | %weightage |
|---|---|---|
| **CO-1** | Understand fundamentals of image processing and computer vision. | **15** |
| **CO-2** | Understand and apply concepts of Image formation and Image Enhancement. | **25** |
| **CO-3** | Understand and apply image segmentation and feature extraction methods. | **20** |
| **CO-4** | Acquire knowledge about various Object Detection, Object Recognition, Motion estimation techniques and their applications. | **25** |
| **CO-5** | Ability to apply various Image processing and Computer vision algorithms to solve real time problems. | **15** |

| **Curriculum Revision:** | |
|---|---|
| Version: | 1.0 |
| Drafted on (Month-Year): | June-2020 |
| Last Reviewed on (Month-Year): | - |
| Next Review on (Month-Year): | June-2025 |