# School of Computer Engineering

Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University
Bhubaneswar-751024

## Lesson Plan and Activity Calendar

**Computer Vision – CS30026 (L-T-P-Cr: 3-0-0-3)**

**Semester:** 5th
**Discipline:** B.Tech. (CSE), **Section:** CSE-09
**Session:** Autumn 2025

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### Instructor:

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### Course Objective:

- To understand image formation and camera calibration
- To understand stereo vision and stereo camera geometry
- To be able to know structures from motions
- To know machine learning for computer vision

### Lesson Plan:

| Unit | Unit Name | Topics to be covered | No. of lectures | Lecture serial nos. |
|---|---|---|---|---|
| 1 | Image formation and camera calibration | ● Introduction to computer vision<br>● Geometric camera models,<br>● Orthographic and perspective projections, Weak perspective projection<br>● Intrinsic and extrinsic camera parameters<br>● Linear and nonlinear approaches of camera calibration. | 8 | 1-8 |
| | | Activity1 | | |

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|---|---|---|---|---|
| **2** | **Feature detection and matching** | • Point operators<br>• Convolution and Filtering<br>• Image Enhancement<br>• Histogram Processing<br>• Edge detection<br>• Interest points and corners<br>• Local image features, Feature matching<br>• Hough transform<br>• RANSAC<br>• Scale invariant feature matching<br>• Histogram of Oriented Gradients (HOG)<br>• Speeded up robust features (SURF)<br>**Activity2** | **9** | **9-17** |
| **3** | **Stereo Vision** | • Stereo camera geometry and epipolar constraints<br>• Essential and fundamental matrix, Image rectification<br>• Local methods for stereo matching: Correlation and multi-scale approaches<br>• Global methods for stereo matching: Order constraints and dynamic programming, Smoothness and graph-based energy minimization, Optical flow.<br>**Activity3** | **7** | **18-24** |
| **4** | **Shape from Shading** | • Modeling pixel brightness, Reflection at surfaces<br>• The Lambertian and specular model, Area sources,<br>• Photometric stereo: Shape from multiple shaded images, Modeling inter-reflection, Shape from one shaded image.<br>**Activity4** | **6** | **25-30** |
| **5.** | **Structure from motion** | • Camera self-calibration<br>• Euclidean structure and motion from two images<br>• Euclidean structure and motion from multiple images<br>• Structure and motion from weak-perspective and multiple cameras.<br>**Activity5** | **6** | **31-36** |
| **6.** | **Machine Learning for** | • Introduction to Machine Learning<br>• Image Classification<br>• Object Detection<br>• Semantic Segmentation | **6** | **37-42** |

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|---|---|---|---|---|
| | **Computer Vision** | ● Case study on computer vision and machine learning for applied research.<br>**Activity6** | | |

**Course Outcome:** Upon completion of this course, the students will be able to:

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|---|---|
| **CO1:** | Categorizing of image formation and camera calibration |
| **CO2:** | Apply the concepts of feature detection, Feature reduction, and matching. |
| **CO3:** | Analyze the concepts of stereo vision and stereo camera geometry |
| **CO4:** | Design the concepts of generating shapes from shading |
| **CO5:** | Identifying the concepts of structures from motions. |
| **CO6:** | Determine the concepts of machine learning for computer vision for applied research. |

## Text books:

1. Forsyth, D. A. and Ponce, J., "Computer Vision: A Modern Approach", 2nd Ed., Pearson Education.

## Reference books:

1. Hartley, R. and Zisserman, A., "Multiple View Geometry in Computer Vision", Cambridge University Press.

## Grading Policy:

**Pedagogy:** Lecture, Assignments, Quiz, Debate, Short Projects, etc.

**Evaluation Methodology:** Internal: 50 (20- Midterm Exam & 30 Activity), End Term: 50

**Distribution of Marks:**

| SL No. | Evaluation Component | Evaluation Marks | Course Lecture No. | | Mode |
|---|---|---|---|---|---|
| | | | From | To | |
| 1 | Mid-Semester Examination | 20 | 1 | 17 | Closed Book |
| 2 | Activity based Teaching and Learning | 30 | NA | NA | Open Book, Closed Book and Presentation, Short quiz, Assignments |
| 3 | End-Semester Examination | 50 | 1 | 42 | Closed Book |

## Note #

- ***Tentative Mid-Semester Syllabus would be up to*** Speeded up robust features (SURF) of Module II.

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