



# K. S. INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU, Approved by AICTE  
 Department of Computer Science & Engineering  
**M.Tech SECOND SEMESTER SYLLABUS**

<b>Course: Computer Vision</b>		Semester	II
<b>Course Code</b>	<b>25MSCS215A</b>	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	<b>Theory</b>		

**Course Objectives (Course Skill Set)**

- Explore the fundamentals of image formation.
- Discuss the major ideas, methods, and techniques of computer vision and pattern recognition.
- Able to implement algorithms and techniques to analyze and interpret the visible world around us.

**Module-1**

CAMERAS: Pinhole Cameras, Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases, Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models, Color: The Physics of Color Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

**Module-2**

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges, Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

**Module-3**

The Geometry of Multiple Views: Two Views, Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras, Segmentation by Clustering: What Is Segmentation?, Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering.

**Module-4**

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness, Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples.

**Module-5**

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations, Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, An Application: Mobile Robot Localization, Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants,

Verification, Application: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 25 marks** to attain the COs and POs
3. The sum of two tests, two assignments/skill Development Activities, will be scaled down to **50 marks**.

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper consists of Part A and Part B. Part A consists of 10 questions from 5 modules, each carrying 2 marks.
3. Part B consists of 10 questions. Each full question is for 16 marks. There will be two full questions (with a maximum of three sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**

1. Computer Vision – A Modern Approach, David A. Forsyth and Jean Ponce, PHI Learning, 2009.
2. Computer and Machine Vision – Theory, Algorithms and Practicalities, E. R. Davies, Elsevier 4<sup>th</sup> Edition, 2013.

**Web links and Video Lectures (e-Resources):**

- <https://www.digimat.in/nptel/courses/video/108103174/L19.html>

**Skill Development Activities Suggested:**

The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set):**

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Implement fundamental image processing techniques required for computer vision.	L3
CO2	Perform shape analysis	L2
CO3	Implement boundary tracking techniques	L3
CO4	Apply chain codes and other region descriptors	L3

**Program Outcome of this course:**

Sl. No.	Description	POs
1	<b>Engineering Knowledge:</b> Apply knowledge of mathematics, science, engineering fundamentals, and a specialization to the solution of complex engineering problems.	PO1
2	<b>Problem Analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles.	PO2
3	<b>Design/Development of Solutions:</b> Design solutions for complex engineering problems and design system components that meet specified needs with consideration for public health and safety, cultural, societal, and environmental concerns.	PO3
4	<b>Conduct Investigations of Complex Problems:</b> Use research-based knowledge and methods including design of experiments, analysis, and interpretation of data, and synthesis of information to provide valid conclusions.	PO4
5	<b>Modern Tool Usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools to complex engineering activities with an understanding of limitations.	PO5
6	<b>Engineer and Society / Project Management &amp; Finance:</b> Demonstrate knowledge and understanding of engineering and management principles to manage projects, as well as societal, health, safety, legal, and cultural issues.	PO6

**Mapping of COs and POs**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1		X		X		
CO2			X			
CO3	X				X	
CO4		X				