

MOOC APPROVAL REQUEST

As per KTU B.Tech Regulations 2024, Section 17

KTU COURSE

Code: PECST745
Name: Computer Vision

NPTEL COURSE

Name: Computer Vision and Image Processing - Fundamentals and Applications
Instructor: Prof. M.K. Bhuyan
Institution: IIT Guwahati
Duration: 12 Weeks
Course ID: noc26-ee31

Semester: Jan-Apr 2026 Date: December 02, 2025

Document Contents:

1. KTU Course Syllabus (Complete)
2. NPTEL Course Details
3. Syllabus Comparison Report

SEMESTER S7

COMPUTER VISION

Course Code	PECST745	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To cover the basics of image formation, key computer vision concepts, methods, techniques, pattern recognition, and various problems in designing computer vision and object recognition systems.
2. To enable the learners to understand the fundamentals of computer vision and machine learning models to develop applications in computer vision.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals in Computer Vision :- Camera Calibration- Pinhole camera model, Geometric Image Features - Curves, Surfaces, Analytical Image Features - Elements of Analytical Euclidean Geometry, Geometric Camera Parameters, Stereopsis - Binocular Camera Geometry, Epipolar Constraint, Binocular Reconstruction, Local Methods for Binocular Fusion, Global Methods for Binocular Fusion.	9
2	Features and Filters :- Linear Filters- Linear Filters and Convolution, Shift Invariant Linear Systems. Estimating Derivatives with Finite Differences, Noise, Edges and Gradient-based Edge Detectors Image Gradients - Computing the Image Gradient, Gradient Based Edge and Corner Detection. Filters as Templates - Normalized Correlation and Finding Patterns.	9

3	<p>Machine Learning for Computer Vision :-</p> <p>Machine Learning - Introduction, Dataset for Machine Perception- Labelled and Unlabelled Data, Basics of Classification and Clustering, Multi-Class Perspective.</p> <p>Machine Learning for Computer Vision -Machine Learning -Deep Learning Use Cases.</p> <p>Machine Learning Models for Vision - Image Vision-Pretrained Model, Transfer Learning, Fine-Tuning, Convolutional Networks, Convolutional Filters, Stacking Convolutional Layers, Pooling Layers - AlexNet, VGG19, , Modular architecture - ResNet, Neural Architecture Search Design - NASNet</p>	9
4	<p>Segmentation and Object detection :-</p> <p>Segmentation Using Clustering Methods - Human vision- Grouping and Gestalt, Applications- Shot Boundary Detection, Background Subtraction, Image Segmentation by Clustering Pixels- Simple Clustering Methods, Clustering and Segmentation by K-means</p> <p>Object detection - YOLO, Segmentation-Mask R-CNN and Instance Segmentation, U-Net and Semantic Segmentation, Model Quality Metrics</p> <p><i>A case study to compare performance of various models on a suitable dataset.</i></p>	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 subdivisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the basic concepts and terminologies like Camera Calibration, Stereopsis in computer vision	K2
CO2	Apply filters for feature extraction and for finding patterns.	K3
CO3	Build different machine learning models for computer vision	K3
CO4	Implement segmentation and object detection models	K3
CO5	Analyze different machine learning models for segmentation/object detection.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3	3								3
CO5	3	3	3	3	3							3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer vision: A modern approach	Forsyth, David, and Jean Ponce	Prentice hall	2011
2	Emerging topics in computer vision	Medioni, Gerard and Sing Bing Kang	PHI	2004
3	Practical Machine Learning for Computer Vision	Valliappa Lakshmanan, Martin Görner, Ryan Gillard	O'Reilly Media	2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer vision: algorithms and applications	Szeliski, Richard	Springer Science & Business Media	2010
2	Image Segmentation: Principles, Techniques, and Applications	Tao Lei, Asoke K. Nandi	John Wiley & Sons	2022
3	Deep Learning in Computer Vision Principles and Applications	Ali Ismail Awad, Mahmoud Hassaballah	CRC Press	2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	Computer Vision and Image Processing - Fundamentals and Applications by Prof. M. K. Bhuyan at IIT Guwahati https://onlinecourses.nptel.ac.in/noc23_ee39/preview
2	Computer Vision by Prof. Jayanta Mukhopadhyay at IIT Kharagpur https://onlinecourses.nptel.ac.in/noc19_cs58/preview
3	
4	Deep Learning for Computer Vision by Prof. Vineeth N Balasubramanian at IIT Hyderabad https://onlinecourses.nptel.ac.in/noc21_cs93/preview
	COVID-Net Open Source Initiative - COVIDx CT-3 Dataset https://www.kaggle.com/datasets/hgunraj/covidxct



COMPUTER VISION AND IMAGE PROCESSING - FUNDAMENTALS AND APPLICATIONS

PROF. M.K. BHUYAN

Department of Electrical Engineering
IIT Guwahati

PRE-REQUISITES : Basic co-ordinate geometry, matrix algebra, linear algebra and random process.

INTENDED AUDIENCE : UG, PG and Ph.D students

INDUSTRIES APPLICABLE TO : The software industries that develop computer visions apps would be benefitted from this course.

COURSE OUTLINE :

The intent of this course is to familiarize the students to explain the fundamental concepts/issues of Computer Vision and Image Processing, and major approaches that address them. This course provides an introduction to computer vision including image acquisition and image formation models, radiometric models of image formation, image formation in the camera, image processing concepts, concept of feature extraction and selection for pattern classification/recognition, and advanced concepts like motion estimation and tracking, image classification, scene understanding, object classification and tracking, image fusion, and image registration, etc.

This course will cover the fundamentals of Computer Vision. It is suited for mainly students who are interested in doing research in the area of Computer Vision. After completing the course, the students may expect to have the knowledge needed to read and understand more advanced topics and current research literature, and the ability to start working in industry or in academic research in the field of Computer Vision and Image Processing. They can also apply all these concepts for solving the real-world problems.

ABOUT INSTRUCTOR :

Prof. Manas Kamal Bhuyan received a Ph.D. degree in electronics and communication engineering from the India Institute of Technology (IIT) Guwahati, India. He was with the School of Information Technology and Electrical Engineering, University of Queensland, St. Lucia, QLD, Australia, where he was involved in postdoctoral research. Subsequently, he was a Researcher with the SAFE Sensor Research Group, NICTA, Brisbane, QLD, Australia. He was an Assistant Professor with the Department of Electrical Engineering, IIT Roorkee, India and Jorhat Engineering College, Assam, India. In 2014, he was a Visiting Professor with Indiana University and Purdue University, Indiana, USA. Dr. Bhuyan was a recipient of the National Award for Best Applied Research/ Technological Innovation, which was presented by the Honorable President of India, the Prestigious Fullbright-Nehru Academic and Professional Excellence Fellowship, and the BOYSCAST Fellowship. He is an IEEE senior member. He is currently a Professor with the Department of Electronics and Electrical Engineering, IIT Guwahati, and Associate Dean of Infrastructure, Planning and Management, IIT Guwahati. His current research interests include image/video processing, computer vision, machine learning and human computer interactions (HCI), virtual reality and augmented reality. He has almost 25 years of industry, teaching, and research experience. He is the author of the book text book "Computer Vision and Image Processing: Fundamentals and Applications". For more details www.iitg.ac.in/mkb

COURSE PLAN :

Week 1: Introduction to Computer Vision and Basic Concepts of Image Formation: Introduction and Goals of Computer Vision and Image Processing, Image Formation Concepts.

Week 2: Fundamental Concepts of Image Formation: Radiometry, Geometric Transformations, Geometric Camera Models.

Week 3: Fundamental Concepts of Image Formation: Camera Calibration, Image Formation in a Stereo Vision Setup, Image Reconstruction from a Series of Projections.

Week 4: Image Processing Concepts: Image Transforms.

Week 5: Image Processing Concepts: Image Transforms, Image Enhancement.

Week 6: Image Processing Concepts: Image Filtering, Colour Image Processing, Image Segmentation

Week 7: Image Descriptors and Features: Texture Descriptors, Colour Features, Edges/Boundaries.

Week 8: Image Descriptors and Features: Object Boundary and Shape Representations.

Week 9: Image Descriptors and Features: Interest or Corner Point Detectors, Histogram of Oriented Gradients, Scale Invariant Feature Transform, Speeded up Robust Features, Saliency

Week 10: Fundamentals of Machine Learning: Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Linear Discriminant Analysis.

Week 11: Applications of Computer Vision: Artificial Neural Network for Pattern Classification, Convolutional Neural Networks, Autoencoders.

Week 12: Applications of Computer Vision: Gesture Recognition, Motion Estimation and Object Tracking, Programming Assignments.

SYLLABUS COMPARISON

KTU: PECST745 - Computer Vision

NPTEL: Computer Vision and Image Processing - Fundamentals and Applications

KTU SYLLABUS TOPICS	NPTEL SYLLABUS TOPICS	OK
Module 1: Camera Calibration, Geometric Features, Stereopsis	Image Formation, Camera Models, Stereo Vision	▪
Module 2: Linear Filters, Edge Detection, Image Gradients	Spatial Filtering, Edge Detection, Enhancement	▪
Module 3: ML for Vision, CNN, Transfer Learning	Neural Networks, Deep Learning for Vision	▪
Module 4: Segmentation, Object Detection, YOLO	Image Segmentation, Object Detection	▪

CONTENT OVERLAP: $\geq 70\%$

The above comparison confirms that the NPTEL course content matches at least 70% of the KTU syllabus as required by R 17.4.