Faculty of Engineering & Technology
Master of Technology (M. Tech)
(W. E. F.: 2023-24)

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Name of Faculty	:	Faculty of Engineering & Technology
Name of Program	:	Master of Engineering (M. Tech)
Course Code	:	1MSE07
Course Title	:	Computer Vision
Type of Course	:	PC
Year of Introduction	:	2023-24

Prerequisite	:	Calculus, Linear algebra, Probability, Programming knowledge
Course Objective	:	In this course students will learn basic principles of image formation, image processing algorithms and recognition from single or multiple images (video). This course emphasizes the core vision tasks of scene understanding and recognition. Applications to object recognition, image analysis, image retrieval and object tracking will be discussed.
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	Learn fundamentals of computer vision and its applications
	CO2	Understand the basic image processing operations to enhance, segment the images.
	CO3	Understand the analysing and extraction of relevant features of the concerned domain problem.
	CO4	Understand and apply the motion concepts and its relevance in real time applications
	CO5	Apply the knowledge in solving high level vision problems like object recognition, image classification etc.

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	SEE	CIA	SEE	CIA	
3	0	2	4	70	30	30	20	150

Legends: ***L****-Lecture;* ***T****–Tutorial/Teacher Guided Theory Practice;* ***P*** *– Practical,* ***C*** *– Credit,* ***SEE*** *– Semester End Examination,* ***CIA*** *- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.))*

Course Content

Unit No.	Topics	Teaching Hours	Weightage	Mapping with CO
1	**Overview of computer vision and its applications** Representation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation	7	16**%**	CO1
2	**Image Processing:** Pixel transforms, color transforms, histogram processing, histogram equalization, filtering, convolution, Fourier transformation and its applications in sharpening, blurring and noise removal	`9	20**%**	CO2
3	**Feature detection:** edge detection, corner detection, line and curve detection, active contours, SIFT and HOG descriptors, shape context descriptors, Morphological operations	7	16%	CO3
4	**Segmentation:** Active contours, split & merge, watershed, region splitting, region merging, graph-based segmentation, mean shift and model finding, Normalized cut	6	13%	CO2
5	**Camera calibration:** camera models; intrinsic and extrinsic parameters; radial lens distortion; direct parameter calibration; camera parameters from projection matrices; orthographic, weak perspective, affine, and perspective camera models.	5	11%	CO5
6	**Motion representation:** the motion field of rigid objects; motion parallax; optical flow, the image brightness constancy equation, affine flow; differential techniques; feature-based techniques; regularization and robust estimation	4	8%	CO4
7	**Motion tracking:** statistical filtering; iterated estimation; observability and linear systems; the Kalman filter	4	8%	CO4
8	**Object recognition and shape representation:** alignment, appearance-based methods, invariants, image eigenspaces	4	8%	CO3

Suggested Distribution of Theory Marks Using Bloom's Taxonom						
Level	Remembrance	Understanding	Application	Analyse	Evaluate	Create
Weightage	**40**	**20**	**20**	**10**	**-**	**10**

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

Suggested List of Experiments/Tutorials

Sr. No.	Name of Experiment/Tutorial	Teaching Hours
1	Implementing various basic image processing operations in python/matlab/open-CV: Reading imge, writing image, conversion of images, and complement of an image	2
2	Implement contrast adjustment of an image. Implement Histogram processing and equalization.	2
3	Implement the various low pass and high pass filtering mechanisms.	2
4	Use of Fourier transform for filtering the image.	2
5	Utilization of SIFT and HOG features for image analysis.	2
6	Performing/Implementing image segmentation	2
7	Implement optical flow computation algorithm.	2
8	Demonstrate the use of optical flow in any image processing application.	2
9	Object detection and Recognition on available online image datasets	2
10	Character or digit or face classification project.	2

Reference Books

Sr. No.	Name of Reference Books
1	Computer Vision: Algorithms and Applications, R. Szeliski, Springer, 2011.
2	Introductory techniques for 3D computer vision, E. Trucco and A. Verri, Prentice Hall, 1998.