GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Electronics & Communication (Signal Processing Technology)

Course / Subject Code : ME01026021

Course / Subject Name : Computer Vision

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PEC

Prerequisite:	**Digital Signal Processing**
Rationale:	PG Students of EC Engineering need to possess good understanding of the fundamentals and applications of image formation models, feature extraction, motion detection and estimation techniques. They should be able to develop small applications and detect the objects.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Study the image formation models and feature extraction for computer vision	U
02	Identify the segmentation and motion detection and estimation techniques	A
03	Develop small applications and detect the objects in various applications	C

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Image Formation Models** : Monocular imaging system • Orthographic & Perspective Projection • Camera model and Camera calibration • Binocular imaging systems, Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Stereo vision	9	20
2.	**Feature Extraction** : Image representations (continuous and discrete) • Edge detection, Edge linking, corner detection, texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection, Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.	9	20
3.	**Shape Representation and Segmentation** : Deformable curves and surfaces • Snakes and active contours • Level set representations • Fourier and wavelet descriptors • Medial representations • Multi-resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation	9	20
4.	**Motion Detection and Estimation** : Regularization theory • Optical computation • Stereo Vision • Motion estimation, Background Subtraction and Modelling, Optical Flow, KLT, SpatioTemporal Analysis, Dynamic Stereo; Motion parameter estimation • Structure from motion, Motion Tracking in Video	9	20
5.	**Object recognition** : Hough transforms and other simple object recognition methods • Shape correspondence and shape matching • Principal component analysis • Shape priors for recognition	4	10
6.	**Applications of Computer Vision:** Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing	5	10
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**20**	**30**	**10**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. D. Forsyth and J. Ponce,"Computer Vision - A modern approach", 2nd Edition, Pearson Prentice Hall, 2012
2. Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1st Edition, SpringerVerlag London Limited, 2011.
3. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.
4. K. Fukunaga, "Introduction to Statistical Pattern Recognition", 2ndEdition, Morgan Kaufmann, 1990.
5. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008. • B. K. P. Horn, "Robot Vision", 1st Edition, McGraw-Hill, 1986.
6. E. R. Davies "Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc, 2012.

(b) Open source software and website:

- https://nptel.ac.in
- OpenCV, MATLAB

Suggested Course Practical List: Software programs based on theory

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