Course Code: CSE3718	**Course Name:** Computer Vision	
Credits: 3 (2-0-2)	**Contact Hours:** 2 Hours Theory & 2 Hours Lab per week	
Batch: 2023, 7th Semester **Academic Year:** 2024-25	**Semester Duration:** 5th Aug 2024 to 6th Dec	
Course Faculty: Dr. Sukhandeep Kaur Email: Sukhandeep.kaur@bmu.edu.in Office: Cabin No. 12, 4th Floor, E2 Building	**Course Coordinator:** **Name:** Dr. Sukhandeep Kaur **Email:** Sukhandeep.kaur@bmu.edu.in **Office:** 12, IV Floor, E2 Building	

Aim of the course: The aim of this course is to help the students understand the fundamental concepts of computer vision and its applications. The course involves hands-on learning in the form of projects and practical sessions. At the end of the course, students will be able to develop efficient programs for numerous computer vision applications to solve real-world complex problems.

Course Overview and Context: In an increasingly visual world, computer vision has emerged as a critical field at the intersection of computer science, artificial intelligence, and image processing having numerous real-world applications. The course will explore various applications of computer vision, such as facial recognition, autonomous vehicles, medical image analysis, and augmented reality, demonstrating its relevance across diverse industries. This course provides a comprehensive exploration of the fundamental concepts, techniques, and practical applications of computer vision. Upon successful completion of the course, students will have the knowledge and skills needed to work on cutting-edge computer vision projects and contribute to the advancement of this dynamic field.

Course Outcomes (CO): At the end of the course the students should be able to do the following:

CO1: Understand the theoretical and practical aspects of computer vision.

CO2: Apply and demonstrate the various computer vision algorithms and techniques to different domains.

CO3: Design framework/technique/algorithm to solve real-life problems using computer vision methods

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Topics of the course:

	Topics	CO	No of Sessions
	Introduction : Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level , Overview of Diverse Computer Vision Applications: Document Image, Analysis, Bio-metrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.	CO1, CO2	2 sessions

	Image formation, camera model, Projective geometry, Homographies, Geometric transformations, The Pinhole camera model, camera calibration, camera extrinsic and intrinsic parameters, Radiometry and reflectance, BRDF, color and lighting. Filters, image pyramids,	CO1, CO2,	4 sessions
	Numerical representation of images, Image stitching, Image-Processing Python Libraries Used in computer vision: OpenCV, Pillow/PIL, SciPy,Scikit-Image etc.	CO1	3 sessions
	Image Processing, Feature extraction, and understanding feature engineering, shape, histogram, color, spectral, texture, Feature analysis, feature vectors, distance /similarity measures, data preprocessing, Edge detection, Edge detection, Edge detection performance, Hough transform, corner detection. Edges - Canny, Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG and Gaussian derivative filters and DWT.	CO1,CO2	5 sesssions
	Motion Estimation : Stereo Vision: two view and multi view stereo, Multiview geometry, epipolar geometry, Structure from motion, Optical Flow and Motion Analysis, parametric motion. Applications in terms of video stabilization, object tracking.	CO2,CO3	3 sessions
	Object Recognition: Traditional Methods: HoG/SIFT features, Bayes classifiers, SVM classifiers; Object Recognition: Deep Learning Methods, Deep neural networks, classification networks, object proposal networks.	CO2, CO3	3 session
	Depth estimation, 3D Reconstruction, and Shape Representation, Diffusion models	CO2	4 sessions
	Segmentation: Contour based representation, Region based representation, Deformable curves and surfaces, Region Growing, Various methods of image segmentation, Semantic Segmentation.	CO2, CO3	4sessions
	Shape Representation and Segmentation: Contour based representation, Region based representation, Deformable curves and surfaces, Region Growing, Various methods of image segmentation, Semantic Segmentation.	CO2, CO3	3 sessions
	Image Understanding and Computer Vision Applications: Pattern recognition methods, Face detection, Face recognition, 3D shape models of faces Application: Surveillance – foreground-background separation –human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians. Learn various application computer vision techniques.	CO3,	4 sessions

CO/PO Mapping:

** 1- low, 2-moderate, 3-high*

CO/PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3			2	2		1		1	1			2			
CO2		3		2	3	3	2		2		2		2			
CO3	3	2	3	2	3	3	1		3	3	3	2		2		

Learning Resources:

Text Book:

1. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA), 2nd Edition, Springer, 2022

Reference books:

2. Solem, Jan. Programming Computer Vision with Python: Tools and algorithms for analyzing images. " O'Reilly Media, Inc.", 2012.
3. Hartley and Zisserman, Multiple View Geometry in Computer Vision, Cambridge University Press, 2004
4. Forsyth and Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2002
5. Palmer, Stephen E. Vision science: Photons to phenomenology. MIT press, 1999.
6. Computer Vision and Image Processing, Adrian Low, Second Edition, B.S.Publications
7. D. Forsyth and J. Ponce, Computer Vision - A modern approach, Prentice Hall

Reference Links: These are a few online resources available for further studies:

i) https://www.coursera.org/learn/introduction-computer-vision-watson-opencv

ii) https://www.coursera.org/learn/computer-vision-basics

iii) https://www.youtube.com/@firstprinciplesofcomputerv3258

Other reference material will be provided as required.

Note: Instructors will regularly post the necessary learning resources such as lecture resources to the online course management portal i.e. Maitri/Google-classroom.

Percentage of Course covered in the suggested Book: 100%

Assessment Pattern: The final grade will be determined by the marks or grades earned during the project's phase-wise evaluations and the end-term assessment. Grading will be conducted using the relative grading method outlined in the university's academic regulations. To be eligible for grading, students must achieve a minimum of 40% of the total marks upon completing all assessments listed in the table below:

Evaluation Component	Weightage (%)	Evaluation Schedule	Rubrics
Assignments/ Mid sem (Experiential Learning)	20%	4th week of September	Written or Viva

Project Phase Evaluation -1	20%	Continues	Project proposal (5) Literature survey (10), Methodology (5)
Quiz	20%	3rd week of October	Topics to be covered will be announced in the class.
End Term Evaluation(Project Evaluation -2)	40%		Project-Based (Panel Evaluation) Publication and report (10) Methodology (10) Results(10) Question(10)

- All evaluations will be based on the work presented by the students as well as the questions asked, or the problems given to code.
- Cases of AI-generated code or plagiarism will be taken seriously and reported according to the university's policy on Unfair Means (UFM). It is essential that all work is original and adheres to academic integrity.
- There is a mandatory requirement to upload the project to a public repository on GitHub.

Experiential Learning (30%):

In this course, students are required to provide the use cases of computer vision techniques to implement something new as part of a project that has not been done before in the literature, either by proposing novel improvements to an existing method, applying existing methods to new types of data, or proposing a new task or dataset. The students are also expected to implement and show the results of the proposed solution or attempt to re implement and improve on a research paper on a topic of their choice. Hence, this course contributes 70-80% for experiential learning.

Student Responsibilities:

- Attend lectures and do the work Lab Assignments as per instructions.
- Participate in the discussions/assignments held during classes.
- Check announcements on the LMS and emails regularly.
- Submit the assigned task on time.
- Regularly check marks on the LMS to ensure they are up to date.
- Participate in class and take necessary actions to grasp the material. Asking questions is encouraged.
- Communicate any concerns by speaking directly with the instructor.

Attendance Policy: Students are expected to attend classes regularly. Failure to follow the classes regularly and adhere to the expected attendance percentage will result in losing quiz/lab marks and a reduction of the grade as per the University's grading policy.

Recourse Examination Policy: In case a student fails the course, a one-time recourse is permitted as per the academic regulations of the University. Recourse is allowed only for the End Semester examination.

Make-up policy: No make-up exam will be conducted for unexcused absences. The faculty needs to be informed in advance in case the student is not going to appear for any evaluation component, and it is at the discretion of the faculty to sanction makeup for an evaluation component.
Behavior Expectations: No mobile phones and other distractive gadgets are permitted in the class.
Academic Dishonesty/Cheating/Plagiarism: Plagiarism and dishonesty in any form in any evaluation component will lead to appropriate disciplinary action.