Subject Description Form

Subject Code	COMP5523
Subject Title	Computer Vision and Image Processing
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	• To let the students learn the fundamental principles on the aspects of interdisciplinary research including acquiring, processing, analyzing, understanding and utilizing high-dimensional visual data from the real world; • To equip the students with the knowledge of how to develop artificial intelligent systems which automate tasks that the human visual system can do; • To guide the students to understand the relevant state of art technologies and gain experience throughout a variety of case studies.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. critically review and consolidate various methods for digital image processing and analysis and relate or apply them to different applications. b. grasp various algorithms for vision related tasks and develop creative solutions to practical problems by considering various requirements and complex issues (e.g., legal/social/ethics issues). c. carry out in-depth analysis of the digital image data with different image data models, pattern recognition algorithms and learning theory. d. demonstrate leadership and qualities of reflective practitioners by engaging in a group project on vision related topics and various learning activities. e. communicate effectively to peers and senior colleagues and present quality deliverables through reading and writing reports and documents.
Subject Synopsis/ Indicative Syllabus	1. Introduction a. The background b. An overview of the related fields; c. The development of vision systems 2. Image acquisition and formation models a. Imaging systems b. Geometry of image formation c. Camera models and calibration d. Orthographic and perspective projections 3. The fundamentals of image processing a. Image enhancement b. Image representation c. Image transformations d. Image feature extraction e. Image segmentation 4. High-level image processing a. Image recognition b. Image registration c. Image restoration

	5. Computer vision related tasks a. Low-level vision -- image matching, optical flow and motion analysis b. Middle-level vision: 3D analysis from 2D images -- The geometry of multiple views -- Reconstruction: Shape from X (stereo, shading, defocus, motion, structured light) -- Video tracking, motion detection, scene analysis c. High-level vision: -- Image understanding, object recognition, pose estimation. 6. Computer vision algorithms and applications a. The advanced computer vision algorithms -- Machine learning -- Artificial neural network and deep learning b. The selected computer vision applications -- Content-based image retrieval -- Gesture recognition -- Intelligent character recognition -- Medical imaging -- Mobile robots -- Visual sensor network 7. Professionalism and legal/social/ethics issues related to computer vision (e.g., personal data (privacy) ordinance)
Teaching/ Learning Methodology	Lectures provide students with the content of main concepts and methods of the course, together with comprehensive examples, and class questions/answers/discussions for easy understanding. Tutorials and lab sessions offer the opportunity for students to review and consolidate the lecture and reference materials through exercises and software tools. Project assignments will give students the opportunity to solve practical visual information analysis problems. Written assignments help students to develop a solid foundation of visual information processing and analysis throughout the project work of case studies.
Assessment Methods in Alignment with Intended Learning Outcomes	

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Written assignments and quiz	20	✓	✓	✓	✓	✓
2. Project Assignment	35		✓	✓	✓	✓
3. Examination	45	✓	✓	✓		
Total	100					

	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: Written assignments, tests/quizzes, and examination are used to test and deepen students' understanding of the subject materials while project assignment is used to provide a hands-on experience of how the subject materials are applied.	
Student Study Effort Expected	Class contact:	
	▪ Lectures	26Hrs.
	▪ Tutorials/Labs	13Hrs.
	Other student study effort:	
	▪ Reading	26Hrs.
	▪ Written and Project Assignments, Quizzes/Tests, Examination	40Hrs.
	Total student study effort	**105Hrs.**
Reading List and References	1. D.A. Forsyth and J. Ponce, *Computer Vision: A Modern Approach*, Prentice-Hall, 2003. 2. Gonzalez, Rafael, *Digital Image Processing*, 3rd Ed., Pearson Hall, 2008, ISBN 9780131687288. 3. Richard Szeliski, *Computer Vision: Algorithms and Applications*, 2011 Edition, Springer Publisher, ISBN-13: 978-1848829343 ISBN 10: 1848829345. 4. Goodfellow, Ian, et al. Deep learning. Vol. 1. No. 2. Cambridge: MIT press, 2016. 5. Rafael C. Gonzalez. Digital Image Processing, 4Th Edition. 2018. 6. V Kishore Ayyadevara and Yeshwanth Reddy. Modern Computer Vision with PyTorch: Explore deep learning concepts and implement over 50 real-world image applications. 2020. 7. Proceedings of Proceedings of IEEE Conference on Computer Vision and Pattern Recognition (CVPR). 8. IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI). 9. Relevant articles from other conferences and/or journals such as IJCV, ICCV, and ECCV.	