Title (Units): **COMP 7040 Advanced Topics in Computer Vision and Pattern Recognition (3,3,0)**

Course Aims: To give students some advanced topics in the area of contemporary research of computer vision and pattern recognition

Prerequisite: Research Postgraduate Student Standing

Course Intended Learning Outcomes (CILOs):
Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
	Knowledge
1	Explain basic theories and techniques of computer vision and pattern recognition
2	Identify various approaches and design for computer vision and pattern recognition systems
3	Discuss the advanced topics in computer vision and pattern recognition
	Professional Skill
4	Design and implement a simple computer vision and pattern recognition system which can handle certain problem
5	Apply some new techniques to computer vision and pattern recognition
	Attitude
6	Appraise a variety of research issues in this field

Calendar Description: This course gives students some advanced topics in the areas of computer vision and pattern recognition.

Teaching and Learning Activities (TLAs):

CILOs	TLAs
1-6	Students will learn advanced topics on computer vision and pattern recognition through lectures and tutorials. Besides, assignment(s), and final examination will be designed to evaluate the students' learning performance.
4-6	Students are required to read the research papers and write a term paper focusing on a specific topic in the fields of computer vision and pattern recognition, whereby gaining an in-depth understanding of the latest status of the research development in the field. Students are also required to work on a group project.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Remarks
1	Continuous Assessment	60%	1-6	Continuous assessments are designed to measure how well students have learned the fundamentals and major concepts of computer vision and pattern recognition. Lab exercises, term paper and group project will be designed for individual assessment.
2	Final Examination	40%	1-6	Final examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be analysis and skills based to assess students' knowledge in computer vision and pattern recognition as well as their applications.

Assessment Rubrics:

	Excellent (A)	Good (B)	Satisfactory (C)	Fail (F)
Creativity and originality on	All of the concepts and content are	Most of the concepts and	Some of the new concepts	No new idea

group project	different from the lectures with impressive creativity	content are different from the lectures with good creativity		
Explain, analysis and the use of pattern recognition algorithms	Make good use of algorithms	Often make good use of algorithms	Sometimes make good use of algorithms	Not able to make good use of algorithms
Explain and describe the basic principle of a pattern recognition system	Well explain and describe basic principles of a computer vision and pattern recognition system	Explain and describe basic principles of a computer vision and pattern recognition system	Sometimes explain and describe basic principles of a computer vision and pattern recognition system	Not able to explain and describe basic principles of a computer vision and pattern recognition system
Implementation of pattern recognition algorithm	Fully correct in implementing computer vision and pattern recognition algorithms	Mostly correct in implementing computer vision and pattern recognition algorithms	Partially correct in implementing computer vision and pattern recognition algorithms	Not able to implement computer vision and pattern recognition algorithms

Course Content and CILOs Mapping:

Content	**CILO No.**
I - III	1 - 6

References:

Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010
Klette, Reinhard, Concise computer vision - An introduction into theory and algorithm, Springer, 2014.
Goodfellow, Bengio, and Courville, Deep Learning, MIT Press, 2016.
R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, 2nd Edition, John Wiley & Sons, Inc, 2001.
Reinhard Klette, *Concise Computer Vision: An Introduction into Theory and Algorithms*, Springer, 2014.
IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Transactions on Image Processing
IEEE Transactions on Circuit Systems and Video Technology
International Journal on Computer Vision
The Journal of the Pattern Recognition Society, Pattern Recognition.
Proceedings for IEEE/CVF Conference on Computer Vision and Pattern Recognition
Proceedings for IEEE International Conference on Computer Vision
Proceedings for European Conference on Computer Vision

Course Content in Outline:

Topic

I. Introduction to computer vision and pattern recognition

- How machine sees and recognizes things
- Conventional approach and its limitations
- Applications

II. Deep learning for computer vision and pattern recognition

- Key components and basic architecture of deep neural

network
- Convolution neural network
- Vision transformer-based architecture
- Object detection using R-CNN
- Segmentation using image-to-image neural network
- Learning-based Image Restoration and Computational Photography

III. Advanced and current trend of deep learning models and architectures for computer vision and pattern recognition

- Generative Models (VAEs, GANs, Flow, Diffusion, and others)
- Multimodal Learning Frameworks and Applications (Vision, Text, Audio, Speech, Motion etc.)