Title (Units): **COMP 3160 Computer Vision and Pattern Recognition (3,2,1)**

Course Aims: To give students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition.

Prerequisite: COMP 1210 Data Structures and Algorithms
MATH 1140 Computational Mathematics

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

No.	Learning Outcomes (LOs)
	Knowledge
1	Explain basic theories and techniques in computer vision and pattern recognition
2	Identify various approaches of computer vision and pattern recognition and design the components of the systems for computer vision and pattern recognition
3	Describe and discuss the basic functions and methods for image processing
	Professional Skill
4	Design simple systems for computer vision and pattern recognition which can handle certain problem
5	Gain skills in evaluating, experimenting with, and optimizing the performance of the systems for computer vision and pattern recognition
	Attitude
6	Have a deeper appreciation of research issues in this field

Calendar Description: This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition.

Rubrics:

Excellent (A)	• Achieve the first five LOs, with strong evidence of having achieved the last LO, demonstrating a good mastery of both the theoretical and practical aspects of the knowledge and skills associated with computer vision and pattern recognition • Able to develop correct solutions to problems • Demonstrate a thorough understanding and solid knowledge of computer vision and pattern recognition • Able to apply a variety of techniques and relevant knowledge for solving problems in computer vision and pattern recognition
Good (B)	• Achieve most of the first five LOs, with evidence of having achieved the last LO, demonstrating a good understanding of the knowledge and skills associated with computer vision and pattern recognition • Able to develop correct solutions to problems • Demonstrate a competent level of knowledge of computer vision and pattern recognition • Ability to make use of appropriate techniques and knowledge and apply them to familiar problems
Satisfactory (C)	• Achieve some of the first five LOs, demonstrating a basic level of understanding of the knowledge and skills associated with computer vision and pattern recognition • Able to provide acceptable solutions to problems • Demonstrate an adequate level of knowledge of computer vision and pattern recognition • Ability to make use of some techniques and knowledge and apply them to familiar situations
Marginal Pass (D)	• Achieve few of the first five LOs, with minimal understanding of the associated concepts and underlying methodologies

	• Able to provide solutions to simple problems • Demonstrate a basic level of knowledge of computer vision and pattern recognition • Ability to apply some techniques and knowledge to a limited number of typical situations
Fail (F)	• Achieve none of the first five LOs, with little understanding of the associated concepts and underlying methodologies • Unable to provide solutions to simple problems • Knowledge of computer vision and pattern recognition falling below the basic minimum level • Unable to apply techniques and knowledge to situations or problems

Assessment:

No.	Assessment Methods	Weighting	Remarks
1	Continuous Assessment	30%	Continuous assessments are designed to measure how well students have learned the fundamentals and major concepts of computer vision and pattern recognition.
2	Examination	70%	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.

Learning Outcomes and Weighting:

Content	LO No.
I and IX. Introduction to Components of Computer Vision and Pattern Recognition	1-3
II and III. Basic Theories, Techniques and Algorithms in Computer Vision and Pattern Recognition	1,2,4,5
IV – VIII. Image Representation and Processing	3
Project	6

References:

C.H. Chen, L. F. Pau, P. S. P. Wang, Handbook of Pattern Recognition & Computer Vision, 3rd Edition, World Scientific, 2005.
Y. Y. Tang, L. H. Yang, J. M. Liu and H. Ma, Wavelet Theory and Applications to Pattern Recognition, World Scientific, 2000.
L.G. Shapiro and G. C. Stockman, Computer Vision, Prentice Hall, 2001.
R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, 2nd Edition, John Wiley & Sons, Inc, 2001.
M. Nadler and E. P. Smith, Pattern Recognition Engineering, Wiley, 1993.
IEEE Transactions on Pattern Analysis and Machine Intelligence.
IEEE Transactions on Systems, Man, and Cybernetics (Part B).
The Journal of the Pattern Recognition Society, Pattern Recognition.
International Journal of Pattern Recognition and Artificial Intelligence.
International Journal of Document Analysis and Recognition.

Course Content in Outline:

Topic

I. Overview of Computer Vision and Pattern Recognition

II. Basic Theories and Techniques in Pattern Recognition
A. Bayesian decision theory

B. Parametric techniques
C. Non-parametric techniques
D. Formal linguistics theory
E. Linear discriminant function
F. Syntactic / structural PR techniques
G. Multilayer neural networks

III. Dimensionality Reduction and Feature Selection
A. Optimal number of features in classification
B. Feature extraction techniques in statistical PR
C. Feature extraction techniques in syntactic / structural PR

IV. Image and Image Representation
A. Image devices
B. Picture functions and digital images
C. Digital image formats
D. 3D structure from 2D images and reference frames

V. Image Analysis Basic
A. Pixels and neighborhoods
B. Apply masks to images
C. Connected components labeling
D. Binary image morphology
E. Thresholding gray-scale images

VI. Filtering and Enhancing Images
A. Gray-level mapping
B. Removal of small image regions
C. Image smoothing
D. Median filtering
E. Detecting edges using differencing masks
F. Gaussian filtering and LOG edge detection
G. The canny edge detector

VII. Texture
A. Texture, texels, and statistics
B. Texel-based texture description
C. Quantitative texture measures
D. Texture segmentation

VIII. Object Representation
A. Syntactic approach
B. Graphical approach
C. Tree structures

IX. Applications