Title (Units): **COMP7230 Biometrics (3,2,1)**

Course Aims: This course will introduce the latest biometric technology and its applications. Student will learn basic and fundamental theories and algorithms for different modality of biometrics as well as how to develop a biometric system. While different modalities will be discussed, this course will focus on three most popular biometrics, namely fingerprint, face and iris.

Prerequisite: Nil, but students are expected to have fundamental concept on statistics, linear algebra, as well as reasonable programming skills.

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

No.	Course Intended Learning Outcomes (CILOs)
	Knowledge
1	Describe the different biometrics modalities and its applications
2	Describe the fundamental theories and basic algorithms for fingerprint, face and iris modalities
3	Describe the process in developing a complete biometric system
	Professional Skill
4	Design and implementation of algorithm(s) for a biometric application

Calendar Description: This course will introduce the latest biometric technology and its applications. Student will learn basic and fundamental theories and algorithms for different modality of biometrics as well as how to develop a biometric system. While different modalities will be discussed, this course will focus on three most popular biometrics, namely fingerprint, face and iris.

Teaching and Learning Activities (TLAs):

CILOs	Type of TLA
1, 2, 3	Students will learn biometrics algorithms and applications through lectures and/or tutorials. In order to help students to have good understanding of the theories, laboratory sessions will be designed so that students could apply what they have learnt in lectures. This is also one of the ways to evaluate students' understanding. Besides, written assignment(s) and final examination will be designed to test students' level of understanding.
1, 2, 3, 4	Based on the biometrics algorithms they have learned, students are required to work on a biometric group project which will be implemented using available library or toolbox. Students are required to give a preliminary demonstration as well as a final formal presentation on their project. In both cases, instructor(s), teaching assistant and other students would ask questions related to their project. In this way, we could assess their skills and knowledge as well as understanding on biometrics.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
1	Continuous Assessment	50%	1, 2, 3, 4	Written and laboratory assignments, and group project are designed to evaluate the students understanding and knowledge of biometrics.
2	Examination	50%	1, 2, 3	Final examination questions are designed to assess students understanding of the algorithms in biometrics technology

Assessment Rubrics:

Level of Achievement	Elaboration on Course Grading Description
Excellent (A)	• Achieves all four CILOs with strong evidences • Demonstrates an excellent understanding of biometrics theories and algorithms • Able to apply biometrics algorithms for developing practical applications or systems
Good (B)	• Achieves all four CILOs with evidences • Demonstrates a very good understanding of biometrics theories and algorithms • Able to apply biometrics algorithms for developing practical applications or systems
Satisfactory (C)	• Achieves most of the four CILOs with evidences • Demonstrates a good understanding of biometrics theories and algorithms • Able to apply parts of the biometrics algorithms for developing practical applications or systems
Fail (F)	• Cannot achieves most of the four CILOs with evidences • Demonstrates a poor understanding of biometrics theories and algorithms • Not able to apply parts of the biometrics algorithms for developing practical applications or systems

Course Content and CILOs Mapping:

Content		**CILO No.**
I	Background	1,2,3,4
II	Fingerprint	2,3,4
III	Face	2,3,4
IV	Iris	2,3,4
V	Biometric Fusion	2,3,4
VI	Security and Privacy Issues	1

References:

- Anil K. Jain, Arun A. Ross, Karthik Nandakumar, Introduction to biometrics, Springer 2011.
- Anil K. Jain, Patrick Flynn, Arun A. Ross, Handbook of biometrics, Springer, 2008.
- R Jiang, S Al-Madeed, A Bouridane, D Crookes, A Beghdadi, Biometric security and privacy: opportunities & challenges in the big data era, Springer, 2017
- IEEE Certified Biometrics Program: http://ieee-biometrics.org/index.php/resources/cbp-resources

- IEEE Transaction on Pattern Analysis and Machine Intelligence
- IEEE Transaction on Information Forensic and Security
- IEEE Transaction on Image Processing
- Pattern Recognition Journal

Course Content:

Topic

I. Background
   A. History of biometrics
   B. Introduction to biometric system
   C. Biometrics applications

D. Biometric functionality and macro-environment
E. Fundamental enabling technologies

II. Fingerprint
A. Fingerprint characteristics: patterns (loops, whorls), minutiae points, pores, ridge shape
B. Fingerprint representation
C. Fingerprint recognition algorithms

III. Face
A. Face detection algorithms
B. Facial feature extraction algorithms
C. Face classification algorithms
D. 2D vs 3D face recognition
E. Heterogeneous face recognition

IV. Iris
A. Iris detection algorithms at near an far distance
B. Iris feature extraction algorithms
C. Iris classification algorithms

V. Biometric Fusion
A. Senor level
B. Feature level
C. Score/decision level

VI. Security and Privacy Issues