Title (Units): **COMP4055 Medical Image Processing and Applications (3,2,1)**

Course Aims: The course focuses on two areas. First, students will learn some fundamental image processing techniques and the characteristics of different types of medical images. Students are then able to apply different classical image processing techniques to different types of medical images. In the second part, students will learn the structure and components of a medical imaging management system.

Prerequisite: COMP2015 Data Structures and Algorithms
MATH1005 Calculus
MATH2005 Probability and Statistics for Computer Science

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 concepts and techniques in digital image processing
2	Describe the characteristics and properties of different types of medical images
3	Explain the structure of and components in PASC
	Professional Skill
4	Design and implementation of algorithm(s) for a medical images processing application

Calendar Description: The course focuses on two areas. First, students will learn some fundamental image processing techniques and the characteristics of different types of medical images. Students are then able to apply different classical image processing techniques to different types of medical images. In the second part, students will learn the structure and components of a medical imaging management system. Students will be able to apply the picture archiving and communication systems to the medical images.

Teaching and Learning Activities (TLAs):

CILOs	Type of TLA
1 - 3	Students will learn medical image processing algorithms and image-based medical applications through lectures and tutorials. In order to help students to have good understanding of the medical image processing 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, assignment(s) and final examination will be designed to test students' level of understanding.
1 - 4	Based on the medical image processing algorithms they have learned, students are required to work on a medical imaging 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 medical image processing programming skills as well as understanding on medical imaging applications.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
1	Continuous Assessment	60%	1-4	Written and laboratory assignments, and project are designed to evaluate the students understanding of the principles and practice of medical image processing techniques and applications
2	Examination	40%	1-3	Final examination questions are designed to assess students understanding of the methodology,

				characteristics and techniques of medical image processing and applications

Assessment Rubrics:

	Excellent (A)	Good (B)	Satisfactory (C)	Marginal Pass (D)	Fail (F)
Creativity and originality on group project	All of the concepts and content are different from the lectures with impressive creativity	Most of the concepts and content are different from the lectures with good creativity	Some of the new concepts	Few of the new concepts	No new idea
Explain, analysis and the use of digital image processing algorithms	Make good use of algorithms	Often make good use of algorithms	Sometimes make good use of algorithms	Seldom make good use of algorithms	Not able to make good use of algorithms
Explain the characteristics and properties of different types of medical images	Well explain the characteristics and properties of different types of medical images	Often explain the characteristics and properties of different types of medical images	Sometimes explain the characteristics and properties of different types of medical images	Seldom explain the characteristics and properties of different types of medical images	Not able to explain the characteristics and properties of different types of medical images
Explain and analyze the structure and components in PACS	Well explain and analyze the structure and components in PACS	Explain and analysis the structure and components in PACS	Sometimes explain the structure and components in PACS	Seldom explain the structure and components in PACS	Not able to explain the structure and components in PACS
Implementation of image processing algorithm	Fully correct in implementing image processing algorithms	Mostly correct in implementing image processing algorithms	Partially correct in implementing image processing algorithms	Only few correct in implementing image processing algorithms	Not able to implement image processing algorithms

Course Content and CILOs Mapping:

Content		CILO No.
I	Introduction to Image Processing	1, 2, 4
II	Medical Imaging and Its Properties	1, 2, 4
III	Picture Archiving and Communication Systems (PACS)	2, 3
IV	Case Studies and Applications	2, 3, 4

References:

- G. Dougherty, Medical Image Processing: Techniques and Applications, Springer, 2013
- M. A Haidekker, Medical Image Technology, 1st Ed., Springer, 2013.
- I. Bankman, Handbook of Medical Imaging: Processing and Analysis (Biomedical Engineering), Academic Press, 2008
- H. K. Huang, PACS and Imaging Informatics: Basic Principles and Applications, 3rd Ed., Wiley, 2010.
- G. Dougherty, Digital Image Processing for Medical Applications, Cambridge University Press, 2014.
- P Suetens, *Fundamentals of Medical Imaging*, Cambridge University Press, 2012.

Course Content:

Topic

I. Introduction to Image Processing
   A. Fundamentals of digital image processing
   B. Image enhancement in spatial domain
   C. Image enhancement in frequency domain
   D. Image restoration
   E. Image segmentation
   F. Image compression

II. Medical Imaging and Its Properties
   A. Ultrasonic image
   B. Magnetic resonance image
   C. Computed tomography image
   D. X-ray image

III. Picture Archiving and Communication Systems (PACS)
   A. Architecture and operation of PACS
   B. PACS-based imaging informatics
   C. Integration of PACS with Hospital Information Systems and Radiology Information Systems
   D. Standards, interoperability and workflow protocols

IV. Case Studies and Applications