Subject Description Form

Subject Code	BME5051
Subject Title	Molecular and Functional Imaging: From Body System to Molecules
Credit Value	3
Level	5
Responsible staff & Department/School	Prof Yong Ping ZHENG (BME)
Pre-requisite / Co-requisite/ Exclusion	None
Objectives	To introduce key concepts, principles and specific applications of a variety of functional imaging techniques that are used to reveal how the body works, to detect abnormalities at molecular, cellular, tissue, organ and body system levels, and to provide insight into how functional and molecular imaging techniques and informatics can help guide development of drugs, drug delivery systems and tissue engineering or replacement.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Describe the development of a range of imaging techniques used in health science and technology, with emphasis on functional and molecular imaging b. Demonstrate the ability in discussion of the applications of selected imaging techniques used in health science and technology, from molecular level to whole body level c. Demonstrate the ability in discussion how selected pathological conditions are investigated by these imaging techniques
Subject Synopsis/ Indicative Syllabus	**(1) Introduction of imaging techniques and their significance** • What is functional and molecular imaging? • Application in clinical trials and preclinical studies • Impact on the diagnostic and monitoring approach, treatment strategies, and development of medical devices **(2) Principles of biomedical imaging techniques and their applications from body systems to molecules, with emphasis on functional imaging** The imaging of body systems, organs, tissues, cells and molecules and their biological, biochemical, biomechanical, bioelectrical functions will be discussed systematically. The related image optimization and processing will also be taught in different imaging techniques. The imaging techniques that will be covered are as follows: • Computed Tomography (e.g. peripheral quantitative computed tomography(pQCT), micro-CT) • Magnetic Resonance Imaging (e.g. diffusion, perfusion, functional magnetic resonance imaging, elastography, spectroscopy) • Ultrasound Imaging (e.g. elastography, echocardiography, intravascular imaging, Doppler imaging, perfusion, biomicroscopy, photoacoustic imaging, tissue characterization) • Nuclear Imaging (e.g. positron emission tomography, single photon emission computed tomography) • Endoscopic Imaging (e.g. optical endoscopy, ultrasound endoscopy, fluorescence endoscopy, confocal endoscopy, capsule endoscopy) • Optical and Thermal Imaging (e.g. electron microscopy, confocal microscopy, fluorescence microscopy, optical coherence tomography, infrared microscopy, atomic force microscopy, bioluminescence, near-infrared spectroscopy)

(3) Imaging from man to molecules

The holistic approach will be explored for applications of various imaging techniques and their integration into multi-modality imaging approaches in the study of etiology, diagnosis, monitoring and therapy of selected disease states or organ/tissue functions. . This will be achieved in the lectures but mainly through student group presentation on topics about how different imaging modalities benefit the diagnosis and treatment of various diseases.

Teaching/Learning Methodology

Lectures will be used for the topics (1) and (2). Case study presentations will be used for the topic (3).

Teaching/learning methodology	Intended subject learning outcomes					
	a	b	c			
1. Lectures	√	√	√			
2. Case study presentations		√	√			

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed					
		a	b	c			
1. Assignment	15%	√	√	√			
2. Case Study Presentation/Report	40%		√	√			
3. Mid-term quiz	15%	√	√				
4. Written Assessment	30%	√	√	√			
Total	100 %						

Assignment requires the students to recognize the strengths and weaknesses of the various imaging techniques in studying the structure or activities of body systems, tissues/organs, cells and molecules.

In order to strengthen students' understanding of imaging and its application, students are required to write a case report or a review on the application of the various imaging techniques and their integration into multi-modality imaging approaches for one selected cases. It will be a group project.

The written assessment will assess the students' overall understanding of the subject.

Student Study Effort Expected

Class contact:	
▪ Lectures	33 Hrs.
▪ Case Study and Presentation	6 Hrs.
Other student study effort:	
▪ Self-study	103 Hrs.
Total student study effort	142 Hrs.

Reading List and References	Textbooks *Computed Tomography* Hsieh J. Computed Tomography: Principles, Design, Artifacts, and Recent Advances. Hoboken, N.J.: Wiley & Sons, 2009. Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control, 3rd ed. St. Louis, Mo.: Saunders, 2009. *Magnetic Resonance Imaging* Mitchell DG and Cohen MS. MRI Principles, 2nd ed. Saunders, 2004. Buxton RB. Introduction to Functional Magnetic Resonance Imaging: Principles and Techniques. Cambridge University Press, 2002. *Ultrasound Imaging* Szabo, Thomas L. Diagnostic Ultrasound Imaging : inside out. Burlington, Mass.: Academic Press, 2004. *Nuclear Imaging* Saha GB. Basics of PET Imaging: Physics, Chemistry, and Regulations, 2nd ed. New York: Springer, 2010. Vallabhajosula S. Molecular Imaging: Radiopharmaceuticals for PET and SPECT. New York: Springer, 2009. *Optical and Thermal Imaging* Fujimoto JG and Farkas DL. Biomedical Optical Imaging. Oxford: Oxford University Press, 2009. Diakides NA and Bronzino JD. Medical Infrared Imaging. Boca Raton: CRC Press, 2008.