Subject Description Form

Subject Code	BME42113
Subject Title	**Biomedical Imaging**
Credit Value	3
Level	4
Prerequisite	AP10006 Physics II; and AMA2511 Applied Mathematics I; and AMA2512 Applied Mathematics II
Objectives	This subject is for undergraduate students in biomedical engineering and other related programs. It presents a systematic overview of principles and systems of biomedical imaging and fundamental image processing and visualization methods. It aims to equip students with knowledge on each imaging modalities and their specific clinical and research applications, with the understanding of their strengths and limitations. The subject also delivers practical skills to students using MATLAB software for image visualization and processing.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Demonstrate understanding of the principles of medical imaging systems, including X-ray, computed tomography (CT), magnetic resonance imaging (MRI), radionuclide imaging (PET, SPECT), ultrasound, and optical imaging; b. Select proper imaging modalities for different medical applications with the consideration of the strengths and limitations of each imaging modality; c. Demonstrate understanding of image data collection, resolution, reconstruction, storage, processing, visualization, fusion, and communication. d. Design basic image processing methods to enhance image quality and visualization and use MATLAB software to program corresponding functions.
Contribution to Programme Outcomes (Refer to Part I Section 10)	▪ Programme Outcome 1: Demonstrate an ability to apply knowledge of mathematics, science, and engineering appropriate to the Biomedical Engineering (BME) discipline. (Teach and Practice) ▪ Programme Outcome 4: Demonstrate an ability to identify, formulate, and solve BME problems. (Teach and Practice)

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Programme Outcome 7: Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for BME practice. (Teach and Practice)
Programme Outcome 8: Demonstrate an ability to use the computer/IT tools relevant to the BME discipline along with an understanding of their processes and limitations. (Teach and Practice)

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<tr><td>Subject Synopsis/ Indicative Syllabus</td><td>X-ray; computed tomography (CT); magnetic resonance imaging (MRI); radionuclide imaging; positron-emission tomography (PET); single photon emission computed tomography (SPECT); ultrasound imaging; optical imaging; digital image processing.</td></tr>
<tr><td>Teaching and Learning Methodology</td><td>Students will learn the principles of different imaging modalities and systems as well as methods for image visualization and processing in the lectures. The energy used for imaging and physical properties detected will be highlighted. Visiting to medical imaging facilities in clinics and hospitals will be arranged for students. Students in small group will practice ultrasound imaging devices for morphological and blood flow measurement. MATLAB software together with its Image Progress toolbox will be used in the laboratories for students to gain practical experiences. For the students to appreciate the power of biomedical imaging, its application for cancer diagnosis will be consistently used as an example in the whole subject, from the imaging principles, image processing, to MATLAB practices.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td></td><td></td></tr>
<tr><td>Homework assignments, and group presentation</td><td>50%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>Final exam</td><td>50%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>Total</td><td>100%</td><td colspan="6"></td></tr>
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Note: To pass this subject, students must obtain grade D or above in both continuous assessment and final examination.
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	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: The assignments and exams are used to assess the degree that the students understand the knowledge related to biomedical imaging and ability to apply the knowledge to solve practical problems. The lab sessions are focused on evaluating the students on how much they gain practical experiences and how good they use MATLAB to solve real questions in image processing and visualization. The group presentation for a selected topic related to biomedical imaging is used to assess the student's capability in integrating knowledge to handle clinical or research questions and present cohesively to audiences.	
Student Study Effort Expected	Class contact:	
	▪ Lectures	36 Hrs.
	▪ Presentation	3 Hrs.
	Other student study effort:	
	▪ Self-study	48 Hrs.
	▪ Assignments, lab report, and group presentation	30 Hrs.
	Total student study effort	117 Hrs.
Reading List and References	▪ Suar, Mrutyunjay; Misra, Namrata; Bhavesh, Neel Sarovar, *Biomedical Imaging Instrumentation: Applications in Tissue, Cellular and Molecular Diagnostics*, San Diego: Elsevier Science & Technology; 2021 ▪ Suresh, Annamalai; Udendhran, R; Vimal, S, *Deep Neural Networks for Multimodal Imaging and Biomedical Applications*, Hershey: IGI Global; 2020	
Date of Last Major Revision	14 July 2014	
Date of Last Minor Revision	30 June 2023	