

The Syllabus Enhancement for Medical Imaging in Biomedical Electronics Engineering At University Malaysia Perlis

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Abstract— Biomedical engineering has only recently emerged as its own discipline, compared to many other engineering fields; such an evolution is common as a new field transitions from being an interdisciplinary specialization among already-established fields, to being considered a field in itself. University Malaysia Perlis (UniMAP) is one of the public higher learning institutions in Malaysia that offer Biomedical Electronics Engineering at the undergraduate level. One of the core subjects in this program is Biomedical Imaging. This is because Biomedical Imaging is a major segment of medical devices. This area deals with enabling clinicians to directly or indirectly "view" things not visible in plain sight (such as due to their size, and/or location). This can involve utilizing ultrasound, magnetism, UV, other radiology, and other means. Imaging technologies are often essential to medical diagnosis, and are typically the most complex equipment found in a hospital including fluoroscopy, nuclear medicine, positron emission tomography and etc.

Keywords— Biomedical Imaging, Biomedical Electronic Engineering, University Malaysia Perlis, Malaysia.

I. INTRODUCTION

University Malaysia Perlis as known as UniMAP is one of the public university in Malaysia that was established in February 2006. UniMAP is a technical university which intended to apply lab intensive and practical oriented. This is to ensure that graduates from UniMAP are able to directly perform their task without further training in the industry. The aim of technical universities is to produce capable engineers with competency in carrying out practical tasks with

sufficient theoretical knowledge as required by Malaysia's industry [1].

UniMAP had identified electronic based engineering as her niche area. However, areas which related or supporting the advancement of electronic engineering are also introduced. One of these programs is Biomedical Electronic Engineering [2]. The program is the third offered under School of Mechatronics besides Mechanical Engineering Program and Mechatronic Engineering Program. Furthermore, UniMAP is the third public university to offer this program after Universiti Malaya and Universiti Teknologi Malaysia. On 2nd July 2006, UniMAP has received their first batch of undergraduate students that totaled about 46 of them.

Medical Imaging is a subject that deals with the imaging modalities for medicine application. It is offered every 1st semester at School of Mechatronics Engineering.. Generally, the lecture of this subject will focus on the basic principles of imaging modalities, the application and etc. In addition, few lab modules was created to enhance student's understanding in each topics that been taught during lecture session.

II. OVERVIEW

In the clinical context, medical imaging is generally equated to radiology or "clinical imaging" and the medical practitioner responsible for interpreting (and sometimes acquiring) the images is a radiologist. Diagnostic radiography designates the technical aspects of medical imaging and in particular the acquisition of medical images. The *radiographer* or *radiologic technologist* is usually responsible for acquiring medical images of diagnostic

quality, although some radiological interventions are performed by radiologists.[3]

As a field of scientific investigation, medical imaging constitutes a sub-discipline of biomedical engineering, medical physics or medicine depending on the context: Research and development in the area of instrumentation, image acquisition (e.g. radiography), modelling and quantification are usually the preserve of biomedical engineering, medical physics and computer science; Research into the application and interpretation of medical images is usually the preserve of radiology and the medical sub-discipline relevant to medical condition or area of medical science (neuroscience, cardiology, psychiatry, psychology, etc) under investigation. Many of the techniques developed for medical imaging also have scientific and industrial applications.

Medical imaging is often perceived to designate the set of techniques that noninvasively produce images of the internal aspect of the body. In this restricted sense, medical imaging can be seen as the solution of mathematical inverse problems. This means that cause (the properties of living tissue) is inferred from effect (the observed signal). In the case of ultrasonography the probe consists of ultrasonic pressure waves and echoes inside the tissue show the internal structure. In the case of projection radiography, the probe is X-ray radiation which is absorbed at different rates in different tissue types such as bone, muscle and fat.[3]

III. ACADEMIC AND SYLLABUS

Biomedical Engineering blends traditional engineering techniques with biological sciences and medicine to improve the quality of human health and life. The discipline focuses both on understanding complex living systems - via experimental and analytical techniques - and on development of devices, methods and algorithms that advance medical and biological knowledge while improving the effectiveness and delivery of clinical medicine [4].

Program Educational Outcome and Program Outcome: Each of Universiti Malaysia Perlis' engineering programs is tailored according to the university's Program Educational Outcomes (PEO) which describes the expected achievements of graduates after graduation in their career and professional life. They are:

1. Providing competent engineers in theoretical as well as practical aspects so that they can do their engineering job related to research and development (R&D), design, manufacture, maintenance, sales and management.

2. Providing support to meet the increasing demand for professional workers mentioned in the National Industrial Development Plan.
3. Contributing through research, consultancy and teaching to the development of the latest tools and systems especially for use and interest of the public.
4. Producing students with high self esteem and patriotism [7].

Program Outcomes (PO) are related to the expectation of what students are able to achieve when they had completed their study in terms of knowledge, skills and behavior. Generally, all engineering degree programs at UniMAP have 11 POs. The students are emphasized to have basic knowledge of mathematics, science and engineering, ability to communicate and ICT literate. Other qualities that have been emphasized by the UniMAPs' POs include high value of ethics, engineering professionalism, entrepreneurship knowledge, ability to solve problem and high technical competency [6].

However, specific POs are drawn to ensure the Biomedical electronic engineers graduating from Universiti Malaysia Perlis are able to meet the industrial requirement. The POs are:

1. Ability to work professionally in the biomedical engineering sector, health care sector and other medical engineering related industry in designing systems, components, products or processes to meet desired needs of these industries
2. Familiarity in experimental design, data collection and data analysis for biomedical engineering knowledge of contemporary analytical, computational, experimental and design practices in biomedical engineering.

Besides PEOs and POs, the Course Outcome (COs) indicates types of competencies which can be realized by the students after having this course is shown in Table 1 below.

Syllabus: Table 2 shows the content of the recent syllabus of Biomedical Electromagnetic Theory which is tailored in order to comply with the PEOs, POs and COs.

Table 1 Course Outcome Matrix

Estimated contact hours	Course Content
	Basic concepts Define biomedical imaging. Describe various types of biomedical imaging modalities, application, the advantages and disadvantages of the modalities used in the clinical situation.
3	Interaction of radiation with matter Define and Explain various types of interaction with matter such as particle interactions, X- and Gamma Rays, absorption of energy from X- and Gamma Rays.
3	Computers in medical imaging Define and Analyze storage and Transfer of data in computers. Explain components, operations, performance of computers used in digital images for medical imaging modalities
3	Diagnostic radiology Define and Analyze the theory of X-Ray production, X-Ray Tubes and Generators.
3	Mammography Define and Analyze the theory of soft x-rays operation applied in mammography. Explain the radiation dosimetry and regulatory requirements for mammography.
6	Ultrasound Define the characteristics of Sound, interactions of ultrasound with matter, transducers and beam properties. Explain image quality and artifacts in ultrasound.
6	Computed tomography (CT) Define and Analyze the basic principles of computed tomography. Explain the detectors and detector array used in CT. Evaluate radiation dose in CT to operators and patients. Review the image quality and artifacts exists in CT. Design layout of CT scan room.
6	Magnetic resonance imaging (MRI) Review image characteristics of MRI. Explain the basic principles of MRI. Define the artifacts that can be existed in MRI system. Define safety and bioeffects to operators and users. Design layout of Magnetic Resonance Imaging room and control room.
6	Radiation protection, dosimetry and biology Define the acts or regulations in Radiation Protection. Explain the radiation dosimetry of patients. Review the interaction of radiation with tissue, response of organ systems to radiation and hereditary effects of radiation exposure. Design layout of general X-Ray room.

Table 2 Teaching Plan Guide

CO	Course Outcomes (CO)
1	Ability to describe the concept of medical imaging modalities used in clinical application.
2	Ability to explain and evaluate for each types of medical imaging modalities in term of characteristics, interaction with tissues and radiation protection.
3	Ability to explain and illustrate tissue reactions to radiation.
4	Ability to select suitable modalities that can be used in various clinical situation and explain the criteria that will lead to a successful diagnostic.

References books: Some references book that are used in order to design the new syllabus for Medical Imaging are stated as below;

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IV. LABORATORY

At UniMAP, laboratories developed are specific to the courses offered by the program. The lab session is a crucial thing in UniMAP due to the learning approaches which is focusing on practical based oriented. For the time being, medical imaging laboratory have shared with Anatomy and Physiology Lab. However, the program has planned to set up Medical Imaging Lab. The medical imaging equipments for teaching purposes have obtained gradually based on the budget provided by university. For now, the lab has hand phantom, ultrasound, Geiger Muller counter, Survey Meter, Personal Dose Meter, step

wedges and etc. UniMAP's has planned to buy General X-Ray for clinic used and teaching purposes. For medical imaging subject, seven lab modules have designed to enhance the basic understanding for the important topic in lecture class. The seven lab modules cover of Image Processing using Image J software, Ultrasound and radiation protection which is required student to design room layout for medical imaging modalities such as general X-Ray, CT Scan and etc.

v. CONCLUSION

The growth of biomedical engineering industry especially in hospital support services has created demands for more biomedical engineers in Malaysia. Hence, the School of Mechatronic Engineering through the Biomedical Electronics Engineering program is trying the best in accordance with the current situation and a much more promising future to come. Since the labor market for this program is healthcare industry, graduates must be provided knowledge from engineering skill to medical knowledge. Medical imaging is one of the important parts in healthcare industry. It is hoped that through this course, the students should also establish the right intuition and professionalism in the biomedical engineering discipline.

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