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ENGINEERING & MEDICINE SYMBIOSIS – AN EDUCATIONAL PERSPECTIVE

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Abstract

Biomedical Engineering integrates knowledge from Engineering, Science, and Technology to solve health-related problems in Biology and Medicine. Eventually, Biomedical Engineers work shoulder to shoulder with medical specialists in various health-care applications and research. A Biomedical Engineering unit was introduced by this author into a course of Mechatronic Engineering in WSU to reflect an increasing interaction between Engineering and Medicine and prepare future professionals for meeting health-related engineering challenges ahead. This involved inviting medical professionals and engineering specialists to address students about application of engineering tools in the course of their practice and also liaising with the School of Nursing as well as with the local Hospital. Such an approach was very well received by all who participants in the process. Since WSU has a School of Medicine, School of Nursing and School of Engineering, it is now in a position to start a Biomedical Engineering undergraduate degree.

Keywords*:* Mechatronic Engineering, health related problems, Biomedical Engineering

1. INTRODUCTION

Biomedical Engineering is becoming of an increasing interest and relevance, as stated by Harris et al. (2002), who also acknowledged the pivotal role of learning and knowledge focus in the implementation of novel tools and methods in Medical Practice. As the aging population numbers are increasing globally, Biomedical Engineering as a discipline is getting increasingly relevant as a part of an undergraduate engineering program (Knowles and DeCoito, 2020). Javaid et al. (2023) discussed several innovative aspects of Biomedical Engineering and highlighted how this can assist in developing new medical tools. According to the World Health Organization (WHO), health is a basic human right, and the healthcare researchers play a big role to facilitate health facilities to public (Lanier et al., 2022).

While Engineering and Medicine fulfil disparate functions, they both have a synergistic role to play. Medicine is inherently focused on health and wellbeing, while Engineering is one of several enabling factors that significantly contribute to the medical intervention. Because of a variety of medical conditions that present themselves, a series of engineering devices is often required to provide the necessary information for the appropriate medical intervention. While many such devices have already become a standard in General Medical Practice (e.g., thermometer, stethoscope, oximeter, microscope, X-rays and ultrasound), a specialization often requires unique tools – all readily provided by

Engineering, an inexhaustive source of innovative devices to meet the specific medical challenges of interest. The basis of this technical synergism between the two disciplines is the traditional role of Engineering as an enabling discipline fulfilling servicing needs of all sectors of the society.

The question then may arise, given the complexity of a modern lifestyle, where does this symbiosis formally reside – at least in the case of Engineering and Medicine? It is being addressed in Biomedical Engineering – an Engineering specialization focused on providing tools for applications in medicine to serve the medical practitioner.

A total of 11 universities offers Biomedical Engineering in Australia: The University of Sydney, New South Wales University, University of Technology Sydney, The University of Wollongong, The University of New Castle, The University of Melbourne, RMIT University, The Adelaide University, The University of Queensland, University of Tasmania, The University of Western Australia. Western Sydney University has yet not started the Biomedical Engineering Course.

The aim of this paper is to provide a glimpse into Biomedical Engineering unit in an Engineering Course conducted by the author.

2. BIOMEDICAL ENGINEERING: AN INTERDISCIPLINARY BRIDGE

When confronted with tasks posed by medical challenges, Biomedical Engineering evolved as a dedicated discipline to tackle such problems. It is Biomedical Engineering, effectively a subset of Mechanical Engineering, which, by its nature, draws upon elements of all Engineering disciplines to meet the challenge facing it. However, in an undergraduate Mechanical Engineering course, where the unit usually resides, Biomedical Engineering offers a glimpse that may serve as the starting point for graduate specialization.

The following are a few examples illustrating versatility of medical challenges that resulted in a successfully provided Engineering input:

- Localized treatment of cancer;
- Exoskeleton to enable mobility;
- Cochlear implant to enable hearing;
- Life-support system;
- Measurement of blood pressure;
- Ophthalmic diagnostic systems;
- X-ray diagnoses;
- Kidney dialysis apparatus; and
- Dental applications.

Given an infinite number of applications, the challenge is to construct a syllabus that provides a fertile basis for addressing posed challenges in a classroom setting of a subject specifically addressing the problem basis within its boundaries. This is a formidable task suitable for a course dedicated to providing Engineering Solutions in Medicine. On the other hand, Biomedical Engineering unit within an undergraduate Mechanical Engineering course is a frequent compromise.

This paper provides some such reflections on the author's experience in conducting a Biomedical Engineering subject/unit within an undergraduate course of Mechanical/Mechatronic Engineering.

3. UNIT STRUCTURE

The most successful Biomedical Engineering unit was designed by the author around locally manufactured items and delivered in person by an Engineer involved in its production or design. Also, various medical practitioners were invited (as users of equipment designed by Engineers), to describe and comment on engineering devices used in their practice. This included a Dentist, Surgeon, GP, Practitioner of Chinese Medicine, and a hospital gastroenterologist from the local hospital.

Practical classes involved measuring own blood pressure (each student was given a sphygmomanometer). Also, visiting an operating theatre in the nearby hospital with a view to suggest improvements in the equipment used, provided an excellent challenge as well as education!

Particularly popular with students were practical classes visiting the School of Nursing and the design of a typical hospital bed, patient-controlled device control panels suspended from the ceiling, etc. In addition, students were expected to submit a research topic of their own choice. This above approach generated considerable student interest!

However, Biomedical Engineering as a dedicated discipline provides much wider scope for specialization. The classic Biomedical Engineering Handbook (Joseph D. Bronzino) provides an excellent initial illustration of the complexity of the subject.

4. CONCLUSION

Engineering provides many essential tools for a medical practitioner in performing his/her function, and it is therefore highly advisable to have a dedicated subject (e.g. Biomedical Engineering) in an Engineering Curriculum to help serve this specialist need. In addition, a Biomedical Engineering degree could be started at the Western Sydney University by drawing experts from the Schools of Medicine, Nursing and Engineering as well as the Design and Built Environment unit. Since Western Sydney region is one of the fastest growing regions in Australia, starting a Biomedical Engineering course would also assist in enhancing the health care systems in this region.

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