

Chapter 1

Overview of Biomedical Engineering

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ABSTRACT

Biomedical Engineering is a branch that unites engineering methods with biological and medical sciences in order to enhance the quality of our lives. It focuses on understanding intricate systems of living organisms, and on technology development, algorithms, methods, and advanced medical knowledge, while enhancing the conveyance and success of clinical medicine. With engineering principles, biomedical engineering improves the procedures and devices to overcome health care and medical problems by combining both biology and medicine with engineering principals. In the field of Biomedical Engineering, engineers usually need to have background knowledge from such different fields of engineering as electronics, mechanical, and chemical engineering. Specialties in this field like bioinstrumentation, biomechanics, biomaterials, medical imaging, clinical engineering, bioinformatics, telemedicine and rehabilitation engineering, which will be introduced in this chapter together with an overview of the field of biomedical engineering.

INTRODUCTION

The Whitaker Foundation (2011) defines Biomedical Engineering as:

Biomedical engineering is a discipline that advances knowledge in engineering, biology, and medicine, and improves human health through cross disciplinary activities that integrate the

engineering sciences with the biomedical sciences and clinical practice. It includes: 1) the acquisition of new knowledge and understanding of living systems through the innovative and substantive application of experimental and analytical techniques based on the engineering sciences; 2) the development of new devices, algorithms, processes, and systems that advance biology and medicine and improve medical practice and health care delivery.

DOI: 10.4018/978-1-4666-3604-0.ch001

The Biomedical Engineering Society (1996) states the following definitions for biomedical engineering as part of their career-guidance document:

A Biomedical Engineer uses traditional engineering expertise to analyze and solve problems in biology and medicine, providing an overall enhancement of health care. Students choose the biomedical engineering field to be of service to people, to partake of the excitement of working with living systems, and to apply advanced technology to the complex problems of medical care. The biomedical engineer works with other health care professionals including physicians, nurses, therapists, and technicians. Biomedical engineers may be called upon in a wide range of capacities: to design instruments, devices, and software, to bring together knowledge from many technical sources to develop new procedures, or to conduct research needed to solve clinical problems.

Biomedical engineers working within a hospital or clinic are more properly called clinical engineers, but this theoretical distinction is not always observed in practice, and many professionals working within hospitals today continue to be called biomedical engineers. Biomedical Engineers must have excellent analytical skills, as well as problem-detection and problem-solving skills. They should work well independently, but also be able to work well a member of a team. Having good written and verbal communication skills is also becoming more important, and Biomedical Engineers should also plan to constantly update their training and knowledge by reading current literature and attending conferences and seminars on their specialist subjects (http://www.guidetocareereducation.com/careers/biomedical_engineering). For Biomedical Researchers, the focus is often on adding to the store of knowledge of their specialist subject, rather than on creating new products and items. The knowledge they discover can be used in the development of

biomedical products, or in other areas of medicine, for example to improve treatment methods and speed up patient recovery. Creativity is an important attribute for Biomedical Researchers. For them, the focus of their work is on new ways of understanding the human body and the types of engineering and mechanical devices that can improve medical equipment and patient treatments. In addition, they should have good problem-solving and analytical skills, as well as good written and verbal communication skills.

HISTORY OF BIOMEDICAL ENGINEERING

The history of biomedical engineering involves a sequential and iterative process of discovery and invention: new tools for studying the human body leading to a deeper understanding of body function leading to the invention of improved tools for repair and study of the human body, and so forth (Saltzman, 2009). Table 1 summarizes some major milestones in the Biomedical Engineering Field.

Biomedical Engineering originated during World War II. In 1947, after World War II, administrative committees were established by the Institute for Radio Engineers and the American Institute for Electrical Engineers (forerunner of the Institute of Electrical and Electronics Engineers IEEE) to study biological and medical areas related to engineering (Garfield, 1987). In 1948, the first conference of engineering in medicine and biology was established in the United States, under the sponsoring of the Institute of Radio Engineers, the American Institute for Electrical Engineering, and the Instrument Society of America (Requena-Carrion & Leder, 2009).

Since the formation of Institute of Electrical and Electronics Engineers (IEEE) in 1963, the first issue of *IEEE Transactions on Biomedical Engineering* was published by IEEE Engineering in Medicine and Biology Society (EMBS). In 1968, the Biomedical Engineering Society was formed

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