A Biomedical Engineering Technology Concentration in an Engineering Technology Program

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Abstract

This paper describes the Drexel University's Biomedical Engineering Technology (BET) concentration within the context of an ABET-accredited Bachelor of Science degree in Engineering Technology (ET), including capstone experience on various biomedical technology topics and the specifics of one core BET course. The BET concentration is one of four concentrations available through Drexel's ET program that is offered by the ET Department in the College of Engineering. The other three concentrations are Electrical Engineering Technology (EET), Mechanical Engineering Technology (MET), and Industrial Engineering Technology (IET). The BET concentration has a focus on the practice of medical equipment operation and support in the clinical environment and therefore helps reduce the gap between demand and supply of qualified biomedical engineering technologists. Its development was based on our experience, the program objectives, recommendations made by members of the ET Industrial Advisory Committee, consultations with the faculty and administrators of Drexel's School of Biomedical Engineering, Science and Health Systems, and support by the College of Medicine and the College of Nursing and Health Professions.

Introduction

During the last decade, medical science underwent significant technological changes. Clinical medicine became increasingly dependent on more sophisticated technologies and the complex equipment associated with it[1]. New generation of state-of-the-art medical equipment replaced the previously installed equipment in hospitals and clinics, which required new generation of clinical engineers to properly repair, service, and maintain this equipment. Biomedical engineering technologists also are employed in industry to assure that new products meet the needs of the medical practice.

The concentration in BET will help reduce the gap between demand and supply of qualified biomedical engineering technologists. BET concentration has a focus on the practice of medical equipment operation and support in the clinical environment. A Biomedical Engineering Technology Bachelor's Degree will provide students with the knowledge they need to work in the medical field operating complicated diagnostic and patient care equipment. Students who graduate with a Biomedical Engineering Technology Bachelor's Degree will be able to work in a variety of medical facilities from doctor's offices to hospitals[2]. Specifically, they will be responsible for problem solving, data interpretation, complex troubleshooting, preparation of specifications, scheduling, planning, analysis, project management, and decision making.

BET Curriculum

Drexel's Engineering Technology undergraduate bachelor's program consists of 187.5 total quarter credits[3]. BET curriculum is based on ET core courses supplemented with a combination of courses in biology, human factors, medical terminology, codes and regulations, medical instrumentation, and healthcare administration courses specific to the BET concentration, shown

in red. Courses BET 301, BET 302, BET 303, and BET 305 have been developed specifically for BET concentration. BET courses provided students with a solid basis of hands-on engineering and appropriate engineering technology knowledge in applied biomedical engineering. All courses with BET rubric have similar structure for their syllabi and provide information on how student learning outcomes for a particular course are aligned with ABET student outcomes. Several courses (with BMES rubric) have been adapted from the existing courses of the School of Biomedical Engineering, Science, and Health Systems. Below are brief descriptions of the BET courses.

BET 301 Healthcare Technology

The BET 301 Healthcare Technology course introduces students to the fundamentals of biomedical engineering necessary to work in clinical environment. It discusses a wide variety of medical equipment used in hospitals and clinics. The course objectives are to introduce students to the fundamentals of medical equipment technology that enable them to work in the clinical settings, technically supporting wide variety of medical devices and to become familiar with typical types of medical equipment

BET 302 Biomedical Electronics, 4 credit hours:

This course introduces the fundamentals of analog electronics with an emphasis on biomedical applications. It discusses solid-state devices including diodes, transistors, operational amplifiers, oscillators, and mixers and their use in power supplies, amplifiers and active filters.

BET 303 Medical Imaging Systems, 3 credit hours:

This course explores the fundamentals of medical imaging equipment and discusses the principles of x-ray, computed tomography, ultrasonic, and magnetic resonance imaging systems. As a BET course, the primary focus is on principles of operation, applications, safety, and quality for the imaging equipment.

BET 305 Clinical Lab Equipment, 3 credit hours

This course describes clinical laboratory instrumentation and automation with emphasis on the demands of clinicians for diagnostic information. Special attention is given to reliability, ease of training, and cost effectiveness.

The courses MET 421 Senior Project Design I, MET 422 Senior Project Design II, and MET 423 Senior Project Design III capture the ET capstone experience through 3 quarters of senior design that begin in the fall quarter of the senior year. Faculty, participating industry partners, and students suggest project topics and advisors. Students work with the senior design course instructor, also known as the senior design coordinator, to select projects in the summer prior to entering their senior year. Since the creation of the BET concentration in 2010, the numbers of projects with a focus in biomedical engineering technology have increased. This is due in large to awareness of ET students and the increase interest and participation of ET faculty in the BET program.

Summary

The BET curriculum supplements ET core courses with a combination of courses in biology, human factors, medical terminology, codes and regulations, medical instrumentation, and healthcare administration. BET 301 Healthcare Technology, BET 302 Biomedical Electronics, BET 303 Medical Imaging Systems, and BET 305 Clinical Lab Equipment are courses that are specific to BET concentration. BET courses provide students with a solid basis of hands-on engineering and appropriate engineering technology knowledge in practical biomedical engineering. These courses introduce students to the fundamentals of medical equipment technology to enable them to work in the clinical settings, technically supporting wide variety of medical devices and to become familiar with typical types of medical equipment, including their purpose, functions, block diagrams, troubleshooting techniques, corrective and preventive maintenance (PMs) to ensure patient and user safety and equipment performance accuracy according to the manufacturers' specifications. Courses also introduce students to physical principles and clinical applications of imaging modalities most commonly used in clinical medicine. Each BET course provides specific student learning outcomes for the course that align with ABET student outcomes.

References

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