A bioinstrumentation course for sophomore biomedical engineers

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Abstract

The curriculum for the BSBME degree at the University of Wisconsin-Madison has a series of lecture-laboratory courses: bioinstrumentation, biomechanics, biomaterials, physiology for engineers, modeling of physiological systems, one each semester. Bioinstrumentation is taken in the fourth semester, with prerequisites of calculus, physics, and chemistry. It builds on physics to provide learning of electric circuits, instrumentation, and strength of materials. Because this course also serves as an introduction to the different areas of biomedical engineering, students learn to make measurements in all these areas. For biomechanics, they learn to measure stress and strain of bone and to measure gait. For biomaterials, they learn to measure molecular size and protein adsorption. They learn the principles and practices of measurements in the hospital clinical chemistry laboratory as well as in cardiology, radiology, and other clinics. They learn biostatistics, as well as the newer techniques in biotechnology, such as gene sequencing and biosensors. Twelve laboratories complement the text chapters at www.engr.wisc.edu/coebin/courses98/get/bme/310/webster/.

Timetable listing

BME310 Bioinstrumentation (3 credits). Spring 1999, 11:00 TR + lab M, T 2:25. Prerequisites: Math 223, Physics 202 & Chem 103

Course description

This is a sophomore level first course in bioinstrumentation covering clinical and research measurements. Topics include: Measurement systems, signal processing, measurement of: molecules in clinical chemistry, biomaterials and tissue engineering; hematology; cells in biomaterials and tissue engineering; nervous system; heart and circulation; lungs; kidney; bone; skin; and the body. Twelve laboratory experiments complement the lectures.

This is the first required course in the new undergraduate curriculum in biomedical engineering.Most bioinstrumentation courses have emphasized measurements in the traditional biomedical engineering areas such as biomechanics, medical instrumentation, and medical imaging. I am developing a new text and course, that will build upon these traditional areas to include measurements in areas of growing importance, such as biosensors, cellular engineering, and tissue engineering. I would welcome suggestions for improvement.

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JOHN G. WEBSTER
John G. Webster received the B.E.E. degree from Cornell University, Ithaca, NY, in 1953, and the M.S.E.E. and Ph.D. degrees from the University of Rochester, Rochester, NY, in 1965 and 1967, respectively.

He is Professor of Electrical and Computer Engineering at the University of Wisconsin-Madison. In the field of medical instrumentation he teaches undergraduate and graduate courses, and does research on RF cardiac ablation and measurement of vigilance.

He is author of *Transducers and sensors*, An IEEE/EAB Individual Learning Program (Piscataway, NJ: IEEE, 1989). He is coauthor, with B. Jacobson, of *Medicine and clinical engineering* (Englewood Cliffs, NJ: Prentice-Hall, 1977), and with R. Pallás-Areny, of *Sensors and signal conditioning* (New York: Wiley, 1991) and with R. Pallás-Areny, of *Analog signal processing* (New York: Wiley, 1999). He is editor of *Encyclopedia of medical devices and instrumentation* (New York: Wiley, 1988), *Tactile sensors for robotics and medicine* (New York: Wiley, 1988), *Electrical impedance tomography* (Bristol, UK: Adam Hilger, 1990), *Teaching design in electrical engineering* (Piscataway, NJ: Educational Activities Board, IEEE, 1990), *Prevention of pressure sores: engineering and clinical aspects* (Bristol, UK: Adam Hilger, 1991), *Design of cardiac pacemakers* (Piscataway, NJ: IEEE Press, 1995), *Design of pulse oximeters* (Bristol, UK: IOP Publishing, 1997), *Medical instrumentation: application and design, Third Edition* (New York: Wiley, 1998) *Handbook of measurement, instrumentation, and sensors* (CRC Press, Boca Raton, FL, 1999), and *Encyclopedia of electrical and electronics engineering* (New York: Wiley, 1999). He is coeditor, with A. M. Cook, of *Clinical engineering: principles and practices* (Englewood Cliffs, NJ: Prentice-Hall, 1979) and *Therapeutic medical devices: application and design* (Englewood Cliffs, NJ: Prentice-Hall, 1982), with W. J. Tompkins, of *Design of microcomputer-based medical instrumentation* (Englewood Cliffs, NJ: Prentice-Hall, 1981) and *Interfacing sensors to the IBM PC* (Englewood Cliffs, NJ: Prentice Hall, 1988), and with A. M. Cook, W. J. Tompkins, and G. C. Vanderheiden, of *Electronic devices for rehabilitation* (London: Chapman & Hall, 1985).

Dr. Webster has been a member of the IEEE-EMBS Administrative Committee and the NIH Surgery and Bioengineering Study Section. He is a fellow of the IEEE, Instrument Society of America and the American Institute of Medical and Biological Engineering. He is the recipient of the AAMI Foundation Laufman-Greatbatch Prize and the ASEE/Biomedical Engineering Division, Theo C. Pilkington Outstanding Educator Award.

Biomedical engineer jobs and careers. Biomedical engineers analyze and design solutions to problems in biology and medicine.Â Bioinstrumentation uses electronics, computer science, and measurement principles to develop instruments used in the diagnosis and treatment of medical problems. Biomaterials is the study of naturally occurring or laboratory-designed materials that are used in medical devices or as implantation materials.Â They should also take math courses, including algebra, geometry, trigonometry, and calculus. Courses in drafting or mechanical drawing and in computer programming are also useful. Bachelor's degree programs in biomedical engineering and bioengineering focus on engineering and biological sciences.