# Proposal for Engineering Masters Education in Wireless Health in San Diego

**Contents:**

CASE WESTERN RESERVE UNIVERSITY EST. 1826
*School of Engineering*

Jeffrey L. Duerk, Ph.D.
Dean, Case School of Engineering
Leonard Case Professor
Director, Case Center for Imaging Research

March 23, 2012

Charles Rozek, Ph.D.
Dean, Graduate Studies
Case Western Reserve University
Cleveland, OH 44106

Dear Chuck,

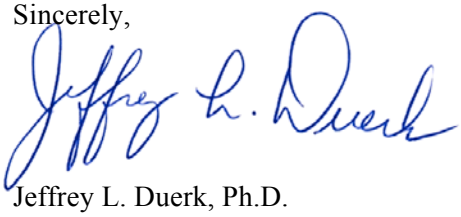
It is my pleasure to provide this note affirming my strongest support for the proposed Master of Science degrees in Wireless Health to be offered by the Departments of Electrical Engineering & Computer Science (EECS) and Biomedical Engineering (BME). As you are well aware, approximately two years ago the faculty leaders in these departments, led by Professor Mehran Mehregany, began the conceptualization, design and implementation of the curriculum. I was Chairman of BME at the time of the initial development and initial deployment and so I am very familiar with the program.

In its current form, the program is offered directly and via distance learning as a certificate program that has demonstrated significant need within the educational marketplace and provided an impactful and meaningful curriculum to the participating students. There are approximately 30 full paying participants and it is anticipated that the demand will continue to be high; operationally it is also going quite well. A separate financial analysis and budget impact statement has been provided for the program.

The BME and EECS departments' committees on graduate education have reviewed the program and its future implementation and both voted affirmatively to support the MS degree option. The votes occurred on March 15 (BME) and March 16 (EECS). The Graduate Education Committee of the School of Engineering has also reviewed this proposal and they too voted affirmatively on March 20. As dean of the School of Engineering, I will assume operational, curricular and financial oversight and responsibility for the program.

I would be grateful if this could be presented to the appropriate committee of the CWRU Faculty Senate for approval as soon as possible so we can successfully transition from the certificate to the degree stage of this important program.

Sincerely,



Jeffrey L. Duerk, Ph.D.
Professor of Biomedical Engineering and Radiology
Dean, School of Engineering
Leonard Case Professor of Engineering
Director, Case Center for Imaging Research
Case Western Reserve University

CASE WESTERN RESERVE UNIVERSITY
CASE SCHOOL OF ENGINEERING

March 27, 2012

Charles Rozek, Ph.D.
Dean, School of Graduate Studies

Dear Dean Rozek,

We are writing to request permission to offer our Masters Program in Electrical Engineering (EE) and Biomedical Engineering (BME) in San Diego, with courses that provide an innovative curriculum in the area of wireless health. Details of the proposed program are provided in the two attachments.

Many companies (over 300) are involved in the rapidly growing wireless health industry. Few of the engineers and others employed in this industry have graduate training in areas that are important to the success of their companies. CSE is in a unique position to provide graduate level training because of our expertise in instrumentation and biomedical engineering, and this program will offer integrated training that many of the employees desire. The proposed masters education program will build on our recent success in offering a program awarding a Certificate in Wireless Health.

We expect approximately 25 students to complete the certificate this May, and many of these same students can be expected to continue to take additional courses in the area of wireless health to earn a masters in BME or EE, beginning as early as this fall. We will continue to offer the Certificate program and will have a mix of certificate and masters students on a regular basis.

We have been fortunate to have a close working relationship with Qualcomm (San Diego), a leading wireless health company, as we roll out our program. CSE is working closely with Qualcomm to develop mutually beneficial research and education interactions. Qualcomm has made available an auditorium on their campus to hold the courses, including access for students who are not Qualcomm employees. In addition, Qualcomm awarded an $80,000 grant to help start up the Certificate program, and has provided exhibit space at major conferences to help promote the educational offerings.

Prof. Mehran Mehregany, with appointments in both EECS and BME, and who is based in San Diego, is leading the startup of this program, and will continue to be its leader. In addition, Prof. Pedram Mohseni in EECS will be the campus based anchor faculty member who will participate in the program and will work with Prof. Mehregany to build a research program paralleling the educational program. We expect additional faculty to undertake research in this field, as its importance expands. For example, wireless health is featured prominently in the recent strategic plan of the National Institute of Biomedical Imaging and Bioengineering of the NIH.

Faculty teaching in this program will have CWRU faculty appointments, typically in the EECS or BME departments of the Case School of Engineering, and all appointments will follow the normal processes and standards of review. We anticipate appointing some adjunct faculty who are based in San Diego, and who are currently employed in the wireless health care industry. Departments handle registration by normal processes, and applications go through Graduate Studies.

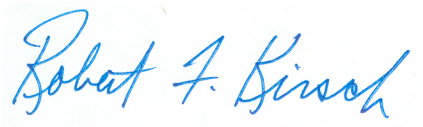
Students are supported by normal mechanisms of office hours and educational clinics that have been offered on-site by Dr. Mehregany. As Program Director, he has overall responsibility for the academic support of the students in the program, assisted by the sponsoring departments. He will serve as advisor for the students physically based in San Diego. Students enrolled in the program on the main campus will be assigned a program faculty advisor on campus. Otherwise distance students will also be advised by the Program Director, assisted by other program faculty as the class size grows. The Program Director will also be the student resource for addressing academic issues brought up by students. He will be assisted by the program faculty as necessitated by increasing class size or the nature of the issue to be addressed.

A distinctive, and highly valuable characteristic of our program is its curriculum, with several integrated courses designed specifically to address the needs of engineers working in this nascent interdisciplinary area. Other programs, including one at USC offer less distinctive programs that mostly assemble existing but disconnected courses related to wireless health. Prof. Mehregany is in the process of editing a textbook that will serve the needs of the foundation course “Introduction to Wireless Health”. This will be the first textbook with this focus.

Development of a financial model for the program has been aided by the launch of the certificate program this last year. The pro-forma model, included as an attachment, shows a profit even in the first year, and a growing income in succeeding years.

We hope that we have adequately explained our proposal to you. We are committed to establishing this program and would be happy to address any concerns quickly.

Sincerely,



Robert F. Kirsch, Ph.D
Prof. BME
Interim Chairman,BME

Michael Branicky, Sc.D.
Prof. EECS
Chairman, EECS

# Pro Forma Budget – Wireless Health Graduate Education Program

| | FY13 | FY14 | FY15 |
|---|---|---|---|
| Student Counts | | | |
| MS-FT | 15 | 18 | 20 |
| MS-PT | 5 | 8 | 10 |
| Cert | 5 | 8 | 10 |
| **Inputs** | | | |
| Total students in program | 25 | 34 | 40 |
| Credit hours per Cert. (fall&spring) | 9 | 9 | 9 |
| perMS-PT | 9 | 9 | 9 |
| perMS-FT | 27 | 27 | 27 |
| Total credits in program | 495 | 630 | 720 |
| Tuition Rate | 1546 | 1608 | 1672 |
| Certificate Credits | 45 | 72 | 90 |
| MS PT Credits | 45 | 72 | 90 |
| MS FT Credits | 405 | 486 | 540 |
| Certificate Tuition Revenue | 69,570 | 115,764 | 150,494 |
| MS-PT Tuition Revenue | 69,570 | 115,764 | 150,494 |
| MS FT Tuition Revenue | 626,130 | 781,410 | 902,963 |
| | | | |
| **Income** | | | |
| Tuition Income from Students less fee est. | 749,965 | 992,680 | 1,179,872 |
| Summer tuition | 0 | 0 | 0 |
| **Expense** | | | |
| Course Instructors | 120,000 | 123,600 | 135,960 |
| Faculty Summer Salary | 22,044 | 22,705 | 23,386 |
| Staff Support | 30,000 | 60,000 | 61,800 |
| Faculty Fringe | 15,613 | 24,812 | 7,250 |
| Video Recording | 15,000 | 15,450 | 16,995 |
| Books for Instructors | 3,000 | 3,090 | 3,183 |
| Misc copying/office supplies/etc. | 3,000 | 3,090 | 3,183 |
| Telephone charges | 2,280 | 2,348 | 2,419 |
| Office supply needs | 600 | 800 | 1,000 |
| Marketing(producton/advertise/shows/etc | 20,000 | 20,600 | 21,218 |
| Travel | 36,000 | 37,080 | 38,192 |
| Consulting Recruiter fees | 30,000 | 30,900 | 31,827 |
| Advertisement | 24,000 | 24,720 | 25,462 |
| Business development meetings | 12,000 | 12,360 | 12,731 |
| Equipment | 25,000 | 15,000 | 15,450 |
| **Subtotal** | 358,537 | 396,555 | 400,055 |
| **Net Return** | 391,427 | 596,125 | 779,816 |

CASE SCHOOL OF ENGINEERING
CASE WESTERN RESERVE UNIVERSITY

*Master of Science*
*Fall 2012 – San Diego, CA*

# Graduate Study in Wireless Health

## *Master of Science*

## *Fall 2012*

*Distance offering? Yes, online!*
*Distance enrollment? Nationwide!*


**WIRELESS MARKET**
**$1.8T**

**HEALTHCARE MARKET**
**$4.5T**

**THE WIRELESS HEALTH MARKET IS PROJECTED TO MORE THAN TRIPLE FROM $2.7B IN 2007 TO $9.6B IN 2012**

**HEALTHCARE IS A CRITICAL GLOBAL ISSUE**

CASE SCHOOL OF ENGINEERING
CASE WESTERN RESERVE UNIVERSITY

*Master of Science*
*Fall 2012 – San Diego, CA*

## Program Description

Ubiquitous connectivity and computing are bringing about unprecedented mobility—allowing working, entertainment, shopping, socializing, gaming, etc., anytime, anywhere. This trend is also infiltrating health care, promising significant improvements in quality, convenience, reach and cost of care through "wireless health" solutions. Wireless health solutions enable diagnosis, therapy and monitoring of health-related conditions by tracking relevant biomarkers, managing treatment regimen and monitoring progress—while the patient goes about his/her daily life, for the most part.

This course-only (i.e., no thesis required) Master of Science (MS) degree in electrical or biomedical engineering offers a rich set of courses, which together provide a solid grounding in fundamentals and a custom tailoring of breadth/depth of study in wireless health. Students who complete this 9-course, 27-credit program will have the requisite knowledge to enter and advance the wireless health industry.

## Educational Objectives

The MS degree provides a comprehensive program that combines theory and practice to cover the entire wireless health value chain, positioning students with exceptional multidisciplinary training for entering and advancing the emerging field of wireless health. A strong basis in fundamentals, across the spectrum of requisite disciplines, is built through 6 topic-specific required courses. Each student further personalizes depth and breadth of study through selection of at least 3 courses from the menu of electives. The required courses and starting menu of electives are outlined in the following table. Each student (team) develops a product plan in E6, which may become the basis of a business plan in E9.

| Course Type | # | Course Title *(prerequisite)*<br>each course is 3 credit hours; MS requires ≥ 27 credits | Format Option | Semester Offered |
|---|---|---|---|---|
| **Required** | R1 | Introduction to Wireless Health | LEC/ITN | Fall & Spring[1] |
| | R2 | The Human Body | LEC/ITN | Fall & Spring[1] |
| | R3 | Health Care Delivery Ecosystem | LEC/ITN | Fall & Spring[1] |
| | R4 | Wireless Communications and Networking | LEC/ITN | Spring & Fall[1] |
| | R5 | Biomedical Sensing Instrumentation ***(R1, R2)*** | LEC/ITN | Spring & Fall[1] |
| | R6 | Life in a Hospital, Clinic or Care Center ***(R1, R2, R3)*** | Rotation | Summer |
| **Elective** | E1 | Principles of Health Care Management ***(R3)*** | ITN | Fall & Spring |
| | E2 | Introduction to Medical Informatics | ITN | Fall & Spring |
| | E3 | Clinical Decision Support Systems | ITN | Fall & Spring |
| | E4 | Advance Biomedical Instrumentation ***(R5)*** | LEC/ITN | Fall & Spring[1] |
| | E5 | Mobile Persuasion & User Experience Engineering | LEC/ITN | Fall & Spring[1] |
| | E6 | New Health Product Development | LEC/ITN | Fall & Spring[1] |
| | E7 | RF Engineering for Medical Devices ***(R4)*** | LEC/ITN | Spring & Fall[1] |
| | E8 | FDA Medical Device Regulations | LEC/ITN | Spring & Fall[1] |
| | E9 | New Health Technology Ventures ***(E6)*** | LEC/ITN | Spring & Fall[1] |

*LEC: Onsite in San Diego* *ITN: Distance Learning - Online format* *[1]Only ITN in the flagged semester*

**Obesity 400M** **Chronic Disease 860M** **Aging 600M** **Compliance $300B**

CASE SCHOOL OF ENGINEERING
CASE WESTERN RESERVE UNIVERSITY

*Master of Science*
*Fall 2012 – San Diego, CA*

## Who Should Attend?

Students with engineering or physical science backgrounds are positioned well to complete the MS program. Students with clinical, health sciences or management backgrounds can also succeed if they have or are willing to gain the necessary background underpinning the engineering-centric courses.

## Admission Requirements

Students will be admitted through the School of Graduate Studies as degree-seeking graduate students in the Case School of Engineering (CSE). Admission will be based on general CSE admission standards for graduate programs, including a minimum GPA of 3.2 in a relevant Bachelor of Science program. GRE is not required. TOEFL is waived for students that have completed a degree program where the language of instruction is English. Otherwise, TOEFL scores must be greater than 100 for the internet-based test (or 550 for the paper-based test).

## Award of the Master of Science (in Electrical or Biomedical Engineering)

Each MS student must complete his/her Program of Study with a cumulative grade point average of 3.0 or greater. A Program of Study must include the 6 required courses and at least 3 elective courses, for a minimum of 27 total credit hours. The courses outlined in the above table constitute a pre-approved Program of Study. Students wishing to substitute other courses, either because they have completed a substantially equivalent graduate level course at another institution of higher education or to obtain a different emphasis, may submit a Revised Program of Study for approval by their academic advisor, the department and the Office of Graduate Studies before their second semester. Students can apply for transfer of credit of up to two equivalent graduate courses (6 credit hours) completed (with a grade of B or better) at another institution of higher learning and not applied toward another degree.

## Timeline for Completion

The MS program may be completed in one calendar year (i.e., consecutive fall, spring and summer semesters) on a full-time basis or in up to three calendar years on a part-time basis. Some of the courses outlined in the above table have one or more prerequisites, which must be considered in constructing one's desired timeline.

## Online Option, Distance Learning and Program Faculty

**Yes!** All lectures and course material are readily available to the students online. The MS degree offering is **available to students nationwide** through online resources. The faculty who are teaching in this program have appointments typically in the Electrical Engineering & Computer Science or Biomedical Engineering Departments of the Case School of Engineering. Their appointments follow the normal processes and standards of internal review.

| Obesity | Chronic Disease | Aging | Compliance |
|---|---|---|---|
| 400M | 860M | 600M | $300B |

CASE SCHOOL OF ENGINEERING
CASE WESTERN RESERVE UNIVERSITY

*Master of Science*
*Fall 2012 – San Diego, CA*

## Class Times and Location

This MS program is an offering of the Case Western Reserve University's San Diego Programs, which follow the same academic calendar as the main campus. Classes are in San Diego, California in the technology-centric Sorrento Mesa area. Each course has one lecture per week, typically from 6:00 PM to 8:30 PM PDT on Mondays, Tuesdays, Wednesdays or Thursdays. In reference to the above table of courses, for Fall 2012, R1 is planned for Tuesdays, R2 for Wednesdays and R3 for Thursdays. E5 and E6 are planned for Mondays. Online version of a course is the same as that onsite, in the semester that the onsite version is offered. Otherwise, the online version is the most recent onsite version.

## Tuition and Financial Aid

The 2011-2012 tuition at Case Western Reserve University is $1,487/credit hour. Case Western Reserve University does not provide internal financial aid for this program. **You should inquire if your employer offers a tuition benefit program.** You may also contact the Office of Financial Aid at 216-368-4530 or financialaid@case.edu to research external aid programs that may be available to you, for example through Federal initiatives.

## Application Deadline and Process

Applications for the Fall 2012 MS program offering will be accepted until all spots are filled or August 7, 2012, whichever comes first. We encourage early application since capacity is limited and spots will be awarded as applications are received and evaluated.

To apply, go to **http://engineering.case.edu/wireless_health**, download the MS application, and complete and submit it. Applications should be submitted through the address listed on the application form.

Your application package must include three letters of recommendation from references who can speak to your abilities and accomplishments that position you to successfully complete the MS program. The recommenders should not share the content of the letters of recommendation with you or other third parties. Each letter should be placed in a sealed envelope, with the recommender's signature across the seal, and be submitted as part of the application package.

You will receive an e-mail acknowledgement after we have your complete application package. We will inform you of our decision within six weeks of having received your complete application package, unless we seek additional information.

## Want more Information?

Visit **http://engineering.case.edu/wireless_health**
Questions can be sent to: **wirelesshealth@case.edu**

| Obesity | Chronic Disease | Aging | Compliance |
|---|---|---|---|
| 400M | 860M | 600M | $300B |

CASE SCHOOL OF ENGINEERING
CASE WESTERN RESERVE UNIVERSITY

*Master of Science*
*Fall 2012 – San Diego, CA*

# Graduate Study in Wireless Health

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*LEC: Onsite in San Diego* *ITN: Distance Learning - Online format* *[1]Only ITN in the flagged semester*

## Bulletin Descriptions of the Courses

**R1 – Introduction to Wireless Health:** Study of convergence of wireless communications, microsystems, information technology, persuasive psychology, and health care. Discussion of health care delivery system, medical decision-making, persuasive psychology, and wireless health value chain and business models. Understanding of health information technology, processing of monitoring data, wireless communication, biomedical sensing techniques, and health monitoring technical approaches and solutions.

**R2 – The Human Body:** Study of Structural organization of the body. Introduction to anatomy, physiology, and pathology, covering the various systems of the body. Comparison of elegant and efficient operation of the body and the related consequences of when things go wrong, presented in the context of each system of the body. Introduction to medical diagnosis and terminology in the course of covering the foregoing**.**

**R3 – The Health Care Delivery Ecosystem:** Heath care delivery across the continuum of care in the United States, including health policy and reform, financing of care, comparative health systems, population health, public health, access to care, care models, cost and value,

comparative effectiveness, governance, management, accountability, workforce, and the future. Discussions of opportunities and challenges for wireless health, integrated into the foregoing topics. Perspective on health care delivery in other countries.

R**4 – Wireless Communications and Networking:** Essentials of wireless communications and networking, including teletraffic engineering, radio propagation, digital and cellular communications, wireless wide-area network architecture, speech and channel coding, modulation schemes, antennas, security, networking and transport layers, and 4G systems. Hands-on learning of the anatomy of a cell phone, and a paired wireless health device and its gateway.

**R5 – Biomedical Sensing Instrumentation:** Study of principles, applications, and design of biomedical instruments with special emphasis on transducers. Understanding of basic sensors, amplifiers, and signal processing. Discussion of the origin of biopotential, and biopotential electrodes and amplifiers (including biotelemetry). Understanding of chemical sensors and clinical laboratory instrumentation, including microfluidics.

**R6 – Life in a Hospital, Clinic and Care Center:** Rotation through one or more health care provider facilities for a first-hand understanding of care delivery practice, coordination, and management issues. First-hand exposure to routine medical devices and instruments, and their related use. Familiarity with provider protocols, physician referral practices, electronic records and clinical decision support systems.

**E1 – Principles of Health Care Management:** Accounting, marketing, finance, law and management for the health care industry. Government policy and its impact on health care management. Knowledge and skills in research, critical thinking, problem solving and current technology for application and use in a health care setting. Teamwork, leadership skills and professional ethics through classroom activities.

**E2 – Introduction to Medical Informatics:** Current and emerging trends in health information systems. Database management, system interoperability, patient privacy, network security, electronic medical records, telehealth, regulatory issues, clinical decision support, mobile documentation devices and wireless communications in healthcare. Impact of wireless health technology and integration to existing health data management systems.

**E3 – Clinical Decision Support Systems:** Design principles behind Clinical Decision Support Systems (CDSS), foundations of knowledge-based systems, pattern recognition systems, inference engines, machine learning, clinical vocabularies, legal and ethical issues. FDA requirements for approving patient-centered clinical decision support systems and CDSS applications in mobile health technology.

*Student develops a new product/service plan in E6, followed by a related business plan in E9.

**E4 – Advance Biomedical Instrumentation:** Analysis and design of biosensors in the context of biomedical measurements. Base sensors using electrochemical, optical, piezoelectric, and other principles. Binding equilibria, enzyme kinetics, and mass transport modalities. Adding the "bio" element to base sensors and mathematical aspects of data evaluation. Applications to clinical problems and biomedical research.

**E5 – Mobile Persuasion and User Experience Engineering:** Social, cognitive, behavioral, and contextual elements of healthcare technology and systems. User-centered design paradigm from a broad perspective, emphasizing how to employ user research techniques to discover needs and create product requirements. Practical utilization of user centered design method and assessment techniques for approaching a design problem.

**E6 – New Health Product Development:** Product development issues faced in medical devices in general and in wireless health in particular. Discussion of the various stages from idea generation through prototype and product development, to validation and clinical/market testing. Techniques and processes for managing different stages of product development process and associated tools. Critical evaluation and analysis of new products and product strategies in wireless health. (*)

**E7 – RF Engineering for Medical Devices:** RF/Wireless connectivity domains for medical applications: NFC (Proximity-IEC 14443, RFID), BAN and PAN (6LowPAN, ANT, BT, ZigBee), LAN (802.11a/b/g/n-MIMO) and WAN. RF Propagation: Body Channel Communications, baseband and modulation (OFDM, CDMA, TDMA). RF Design for medical applications: circuit and RFIC, power management, thermal management, packaging. Antenna Engineering: radiation, materials, Implanted Antennas for Biomedical Applications. RF in medical imaging.

**E8 – FDA Medical Device Regulations:** Understanding the federal system, including separation of powers, the executive branch and its departments, the congress, the Federal Communication Commission, policy versus regulation versus legislative. Learning what is a medical device, including introduction to the Food and Drug Administration, the classification system, radiation emitting products, software, radio-frequency wireless technology in medical devices, converged medical devices, international aspects. Understanding regulation of health information technology and wireless health, including regulatory acts, reimbursement, privacy, security.

**E9 – New Health Technology Ventures:** Processes and techniques for generating and assessing ideas for viable business models in wireless health. Techniques and skills to distinguish between interesting and viable ideas. Possible business models and related challenges for converting a concept into a business. Intellectual property and capturing value through licensing. Case studies illustrating the gap between success and failure in creating and managing a new venture in wireless health. (*)

*Student develops a new product/service plan in E6, followed by a related business plan in E9.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

**INTRODUCTION TO WIRELESS HEALTH**
**FALL 2012**

# EBME/EECS 480A

**COURSE DESCRIPTION:** Study of convergence of wireless communications, microsystems, information technology, persuasive psychology, and health care. Discussion of health care delivery system, medical decision-making, persuasive psychology, and wireless health value chain and business models. Understanding of health information technology, processing of monitoring data, wireless communication, biomedical sensing techniques, and health monitoring technical approaches and solutions. (3 credit hours)

**FACULTY:** The faculty teaching in this program have appointments in a department of the university. Their appointments follow the normal processes and standards of internal review.

**TEXTBOOKS:** *Wireless Health* by Mehregany, ed. (planned for Fall 2012)

**ADDITIONAL MATERIAL:**

*The Creative Destruction of Medicine* by Topol (Basic Books).

*Mobile Persuasion: 20 Perspectives of the Future of Behavior Change,* Fogg and Eckles, eds. (Stanford University)

**COURSE OBJECTIVES:** This course is designed to provide the students with the fundamental and practical knowledge necessary for an overall grasp of the field of wireless health.

**CLASS TIME / LOCATION:** Once a week (not Fridays), 6:00 to 8:30 PM, San Diego.

**OFFICE HOUR / LOCATION:** 4:00 to 6:00 PM, same day and location as lecture.

**COURSE GRADE:**

*Homework (66%):* 6 assignments, biweekly

*Project (34%):* Identify and understand a health or wellness need of a medically underserved group and develop a wireless health solution in response.

**LECTURE SCHEDULE:**

| | |
|---|---|
| WK 1 | Creative destruction of medicine |
| WK 2 | Wireless health applications and devices |
| WK 3 | Persuasion psychology |
| WK 4 | User interface engineering |
| WK 5 | Health care delivery and medical decision making |
| WK 6 | Health information technology and clinical decision support systems |
| WK 7 | Security and interoperability |
| WK 8 | FDA medical device regulation |
| WK 9 | Value chain and business models |
| WK 10 | Wireless communications and networking |
| WK 11 | Wireless sensor networks |
| WK 12 | Biomedical microsystems |
| WK 13 | Near-body health monitoring |
| WK 14 | On-body health monitoring |
| WK 15 | In-body health monitoring |

## University Student Ethics Policy

http://studentaffairs.case.edu/ai/policy.html

**Violations of the Student Ethics Policy will result in failure in the assignment in question or the course, or referral to the academic integrity board as per university policy.**

All forms of academic dishonesty including cheating, plagiarism, misrepresentation, and obstruction are violations of academic integrity standards. Cheating includes copying from another's work, falsifying problem solutions or laboratory reports, or using unauthorized sources, notes or computer programs. Plagiarism includes the presentation, without proper attribution, of another's words or ideas from printed or electronic sources. It is also plagiarism to submit, without the instructor's consent, an assignment in one class previously submitted in another. Misrepresentation includes forgery of official academic documents, the presentation of altered or falsified documents or testimony to a university office or official, taking an exam for another student, or lying about personal circumstances to postpone tests or assignments. Obstruction occurs when a student engages in unreasonable conduct that interferes with another's ability to conduct scholarly activity. Destroying a student's computer file, stealing a student's notebook, and stealing a book on reserve in the library are examples of obstruction.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

**THE HUMAN BODY**
**FALL 2012**

# EBME/EECS 480B

**COURSE DESCRIPTION:** Study of Structural organization of the body. Introduction to anatomy, physiology, and pathology, covering the various systems of the body. Comparison of elegant and efficient operation of the body and the related consequences of when things go wrong, presented in the context of each system of the body. Introduction to medical diagnosis and terminology in the course of covering the foregoing. (3 credit hours)

**FACULTY:** The faculty teaching in this program have appointments in a department of the university. Their appointments follow the normal processes and standards of internal review.

**TEXTBOOK:** *The Human Body in Health and Disease* by Thibodeau and Patton (Elsevier, 5th ed.)

**Additional Material:** *An Introduction to Medical Terminology for Healthcare: A Self-Teaching Package* by Hutton (Churchill Livingstone, 4th ed.)

**COURSE OBJECTIVES:** This course is designed to provide the students with a basic understanding of anatomy, physiology, and pathology, as well as an introduction to medical terminology.

**CLASS TIME / LOCATION:** Once a week (not Fridays), 6:00 to 8:30 PM, San Diego.

**OFFICE HOUR / LOCATION:** 4:00 to 6:00 PM, same day and location as lecture.

**COURSE GRADE:**

*Quizzes (77%):* 7 quizzes, biweekly

*Project (23%):* Virtual dissection of the body

**LECTURE SCHEDULE:**

| | | |
|---|---|---|
| WK 1 | Ch 1/2: | Structure and function of the body/Chemistry of life |
| WK 2 | Ch 3: | Cells and tissues |
| WK 3 | Ch 4: | Organ systems of the body |
| WK 4 | Ch 5: | Mechanisms of disease |
| WK 5 | Ch 6/7: | Integumentary system and body Membranes/Skeletal system |
| WK 6 | Ch 8/9: | Muscular system/Nervous system |
| WK 7 | Ch 10/11: | Senses/Endocrine system |
| WK 8 | Ch 12: | Blood |
| WK 9 | Ch 13/14: | Heart and heart disease/Circulation of blood |
| WK 10 | Ch 15: | Lymphatic system and immunity |
| WK 11 | Ch 16/17: | Respiratory system/Digestive system |
| WK 12 | Ch 18/19: | Nutrition and metabolism/Urinary system |
| WK 13 | Ch 20/21: | Fluid and electrolyte balance/Acid-base balance |
| WK 14 | Ch 22/23: | Reproductive systems/Growth and development |
| WK 15 | Ch 24: | Genetics and genetic diseases |

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**BIOMEDICAL SENSING INSTRUMENTATION**
**SPRING 2013**

# EBME/EECS 480C

**COURSE DESCRIPTION**: Study of principles, applications, and design of biomedical instruments with special emphasis on transducers and in the context of wireless health applications. Understanding of basic sensors, amplifiers, and signal processing. Discussion of the origin of biopotential, and biopotential electrodes and amplifiers (including biotelemetry). Understanding of chemical sensors and clinical laboratory instrumentation, including microfluidics. (3 credit hours)

**FACULTY:** The faculty teaching in this program have appointments in a department of the university. Their appointments follow the normal processes and standards of internal review.

**TEXTBOOK:** *Medical Instrumentation (Application and Design)* by Webster (Wiley, 4th ed.)

**ADDITIONAL MATERIAL:** *Reference Articles and Recitations* to teach underlying concepts in order to accommodate the diversity of student backgrounds.

**PREREQUISITES**: EECS/EBME 480A and 480B.

**COURSE OBJECTIVES:** This course is designed to provide the students with a basic understanding of biomedical instrumentation with emphasis on transducers and in the context of wireless health applications.

**CLASS TIME / LOCATION:** Once a week (not Fridays), 6:00 to 8:30 PM, San Diego.

**OFFICE HOUR / LOCATION:** 4:00 to 6:00 PM, same day and location as lecture.

**COURSE GRADE:**

*Homework (66%):* 6 assignments, ~biweekly

*Project (34%):* Design, build and demonstrate a wireless health device/instrument that communicates with a smart phone for a specific health/wellness application. $200 bill of materials budget (excluding the smart phone).

**LECTURE SCHEDULE:**

| | | |
|---|---|---|
| WK 1 | Ch 1: | Basic concepts of medical instrumentation |
| WK 2 | Ch 14: | Electrical Safety (60 min) |
| | | Workshop: Fundamentals of Design |
| WK 3 | Ch 2: | Basic sensors and principles |
| WK 4 | Ch 2: | Basic sensors and principles |
| WK 5 | Ch 3: | Amplifiers and signal processing |
| WK 6 | Ch 3: | Amplifiers and signal processing |
| WK 7 | Ch 4: | The origin of biopotentials |
| WK 8 | Ch 4: | The origin of biopotentials |
| WK 9 | Ch 5: | Biopotential electrodes |
| WK 10 | Ch 5: | Biopotential electrodes |
| WK 11 | Ch 6: | Biopotential amplifiers |
| WK 12 | Ch 6: | Biopotential amplifiers |
| WK 12 | Ch 10: | Chemical biosensors *(extra lecture)* |
| WK 13 | Ch 10: | Chemical biosensors |
| WK 14 | Ch 11: | Clinical laboratory instrumentation |
| WK 15 | Ch 11: | Clinical laboratory instrumentation |

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**THE HEALTH CARE DELIVERY ECOSYSTEM**
**FALL 2012**

# EBME/EECS 480D

**COURSE DESCRIPTION**: Heath care delivery across the continuum of care in the United States, including health policy and reform, financing of care, comparative health systems, population health, public health, access to care, care models, cost and value, comparative effectiveness, governance, management, accountability, workforce, and the future. Discussions of opportunities and challenges for wireless health, integrated into the foregoing topics. Perspective on health care delivery in other countries. (3 credit hours)

**FACULTY:** The faculty teaching in this program have appointments in a department of the university. Their appointments follow the normal processes and standards of internal review.

**TEXTBOOK:** *Health Care Delivery in the United States* by Jonas and Kovner (Springer Publishing Company, 10th ed.)

**ADDITIONAL MATERIAL:** *Reference Articles* providing a perspective on health care delivery in other countries.

**PREREQUISITES**: None.

**COURSE OBJECTIVES:** This course is designed to provide the students with a basic understanding of health care delivery in the United States and the related opportunities and challenges for wireless health.

**CLASS TIME / LOCATION:** Once a week (not Fridays), 6:00 to 8:30 PM, San Diego.

**OFFICE HOUR / LOCATION:** 4:00 to 6:00 PM, same day and location as lecture.

**COURSE GRADE:**

*Quizzes (77%):* 7 quizzes, biweekly

*Project (23%):* Bridge the gap between an available wireless health solution and the respective current delivery of care it is intended to displace/improve.

**LECTURE SCHEDULE:**

| | | |
|---|---|---|
| WK 1 | Ch 1: | The current U.S. health care system |
| WK 2 | Ch 2: | Health policy and health reform |
| WK 3 | Ch 3: | Health care financing |
| WK 4 | Ch 4: | Comparative health systems |
| WK 5 | Ch 5: | Population health |
| WK 6 | Ch 6: | Public health: policy, practice, and perceptions |
| WK 7 | Ch 7: | Health and behavior |
| WK 8 | Ch 8: | Access to care |
| WK 9 | Ch 9: | Organization of medical care |
| WK 10 | Ch 10: | Integrative models and performance |
| WK 11 | Ch 11: | High quality health care |
| WK 12 | Ch 12: | Health care costs and value |
| WK 13 | Ch 13: | Comparative effectiveness |
| WK 14 | Ch 14: | Governance, management, and accountability |
| | Ch 15: | Health workforce |
| WK 15 | Ch 17: | The future of health care delivery in the U.S. |

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**WIRELESS COMMUNICATIONS AND NETWORKING**
**SPRING 2013**

# EBME/EECS 480E

**COURSE DESCRIPTION:** Essentials of wireless communications and networking, including teletraffic engineering, radio propagation, digital and cellular communications, wireless wide-area network architecture, speech and channel coding, modulation schemes, antennas, security, networking and transport layers, and 4G systems. Hands-on learning of the anatomy of a cell phone, and a paired wireless health device and its gateway. (3 credit hours)

**FACULTY:** The faculty teaching in this program have appointments in a department of the university. Their appointments follow the normal processes and standards of internal review.

**TEXTBOOK:** *Wireless Communications and Networking* by Vijay Garg (Morgan Kaufmann)

**ADDITIONAL MATERIAL:** *Reference Articles and Recitations* to teach underlying concepts in order to accommodate the diversity of student backgrounds.

**PREREQUISITES**: None.

**COURSE OBJECTIVES:** This course is designed to provide the students with a basic understanding of wireless communications and networking.

**CLASS TIME / LOCATION:** Once a week (not Fridays), 6:00 to 8:30 PM, San Diego.

**OFFICE HOUR / LOCATION:** 4:00 to 6:00 PM, same day and location as lecture.

**COURSE GRADE:**

*Homework (77%):* 7 assignments, biweekly

*Projects (23%):* Dissect (i) a cell phone, and (ii) a paired wireless health device and its gateway.

**LECTURE SCHEDULE:**

| | | |
|---|---|---|
| WK 1 | Ch 1: | An overview of wireless systems |
| WK 2 | Ch 2: | Teletraffic engineering |
| WK 3 | Ch 3: | Radio propagation and propagation path-loss models |
| WK 4 | Ch 4: | An overview of digital communication and transmission |
| WK 5 | Ch 5: | Fundamentals of cellular communications |
| WK 6 | Ch 6: | Multiple access techniques |
| WK 7 | Ch 7: | Architecture of a wireless wide-area network |
| WK 8 | Ch 8: | Speech coding and channel coding |
| WK 9 | Ch 9: | Modulation schemes |
| WK 10 | Ch 10: | Antennas, diversity, and link analysis |
| WK 11 | Ch 11: | Spread spectrum and CDMA systems |
| WK 12 | Ch 12: | Mobility management in wireless networks |
| WK 13 | Ch 13: | Security in wireless systems |
| WK 14 | Ch 14: | Mobile networking and transport layer |
| WK 15 | Ch 23: | Fourth generation systems and new wireless technologies |

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**LIFE IN A HOSPITAL, CLINIC OR CARE CENTER**
**SUMMER 2012, FALL 2012, SPRING 2013**

# EBME/EECS 480F

**COURSE DESCRIPTION:** Rotation through one or more health care provider facilities for a first-hand understanding of care delivery practice, coordination, and management issues. First-hand exposure to routine medical devices and instruments, and their related use. Familiarity with provider protocols, physician referral practices, electronic records, clinical decision support systems, acute and chronic care, and inpatient and ambulatory care. (3 credit hours)

**FACULTY:** The faculty overseeing this program have appointments in a department of the university. Their appointments follow the normal processes and standards of internal review.

**TEXTBOOK:** None.

**ADDITIONAL MATERIAL:** None.

**PREREQUISITES**: EECS/EBME 480A, 480B, 480D.

**COURSE OBJECTIVES:** This course is designed to provide the students with a first-hand understanding of health care delivery in a clinical setting.

**TOTAL TIME IN CARE SETTING:** 48 hours.

**COMPLETION TIME:** 6 to 12 weeks, flexible.

**LOCATION:** A hospital, clinic or care center approved by the faculty. Student may suggest site(s).

**COURSE GRADE:** *Diary (100%),* detailing the experience and learning.

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