

## **ECE 493 – Telehealthcare Engineering ABET Syllabus**

**Catalog Data:** ECE 493 Telehealthcare Engineering. Credit 3. Medical signal processing, medical sensors, mobile health system, and medical security & privacy.

**Prerequisites:** ECE 370 Signals and System  
Prerequisite topics: knowledge of signals and systems.

**Textbook/References:**

This is a new course without suitable textbook found.

**Class Schedule:** lectures: three times per week for 50 minutes per meeting.

**Grading Policy:** Total 100 points:

4 quizzes (each quiz 20 minutes, 5 points each)	-- 20%
2 tests (each test 50 minutes, 10 points each)	-- 20%
Final Exam (two and a half hours)	-- 20%
Homework (8~10 assignments)	-- 15%
Labs (6) and project (1)	-- 25%

**Relationship of Course toward Meeting ABET Program Outcomes:**

The course supports instruction for Program Outcomes A, C, F, G, I, K, and L as required by ABET Criterion 3 of EC 2000 and ABET Program Criteria. The relationships are indicated in the Course Educational Objectives.

**Course Learning Objectives:**

The overall course objectives are to introduce electrical engineering and computer engineering students the fundamentals of medical signal analysis and medical sensor design, to understand remote patient monitoring techniques, to develop the tools necessary to analyze patient symptoms in the presence of signal noise, and to determine methods for improving medical data transmission performance. At the end of this course, students are expected to be able to

1. Draw the general model of a remote patient monitoring system, describe the function of each of the blocks, define technical terms relevant to the model, and name the signal processing modules. (Outcome C)
2. Explain the parameters and tradeoffs involved in medical data communication system design. Give examples for various system tradeoffs (e.g. transmission speed vs. bandwidth). (Outcome C, G)
3. Develop and properly use the mathematical tools available for Wavelet analysis of medical signals. (Outcome G) including the mother wavelet choice, time-frequency domain wavelet analysis, and multi-resolution analysis. (Outcomes A, K)
4. Design wireless networks to transmit medical sensor data across wireless channels. Design radio transmitters and receivers, calculate probability of bit errors for various wireless systems, draw waveforms for various data patterns, determine optimum transmission protocols, calculate and draw the received signal waveform after passing a noisy channel. (Outcomes C and L)
5. Define and analyze medical data compression techniques in sampling phase such as compressive sensing. (Outcomes C, K, and L)
6. Define and analyze various techniques for medical data error control coding such as FEC (forward error control). (Outcome C, K, and L)
7. Understand the medical signal sensing, sampling, coding, and communication principles. (Outcomes C and L)
8. Students gain proficiency with Matlab and C programming with medical signal processing. (Outcome K)
9. Problem and examination solutions and background material are given on a course Web site. Students are required to access that information. (Outcome K)
10. Wireless-Sensor-based hardware hands-on labs. This includes EEG, ECG and other medical sensor design (Outcome K)

**Course Assessment for Objectives:**

This course is annually reviewed by the electrical and computer engineering faculty for appropriateness to meeting

program objectives.

**Contribution of Course to Meeting the ABET professional component:**

- Skills required, used, and developed include mathematics, circuit analysis, digital electronics, probability, statistics, Matlab simulation, and wireless sensor programming.
- Estimated Content: Engineering Science – 1.5 credits, and Engineering Design – 1.5 credits

**Topics Covered During Class:**

1. Tele-healthcare system architecture including sensors, communication parts, and signal processing.
2. Mobile-Health: using mobile computing for remote patient monitoring
3. Medical data acquisition devices
  - RFID for medical object recognition such as medicine bottle recognition
  - Medical sensors and sensor network
4. ECG sensor design
  - Sensor circuit
  - ECG sensor design
  - ECG sensor Printed Circuit Board (PCB) design
5. Medical signal analysis
  - Wavelet algorithms
  - Time-frequency domain data visibility analysis
  - DWT (Discrete Wavelet Transform)
6. Bayesian models for medical signal processing
  - Bayesian theorem
  - Maximum Likelihood and Maximum A Posterior for medical signal pattern learning
7. ECG signal processing
  - Heart beat signal patterns
  - Abnormal ECG signal identification via Bayesian models
8. EEG (brain activity) signal processing
9. IMD (implantable medical devices) design
10. Medical privacy and security
12. Labs and project explanations
13. Comprehensive final examination

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