1. **Course number and name:** BEN331 BioMedical Signal Processing
2. **Credits and contact hours:** 3 credits, 45 hours
3. **Instructor’s name:** Jeffrey Denenberg

#### Textbook, title, author, and year:

Smith, Steven W., The Scientist and Engineer’s Guide to Digital Signal Processing, California Technical Publishing, 1997, ISBN: 0-9660176-3-3

#### 4a. Other Supplemental Material:

Reference Materials uploaded to Blackboard

#### 5a. Catalog Description:

This course presents an overview of different methods used in biomedical signal processing. Signals with bioelectric origin are given special attention and their properties and clinical significance are reviewed. In many cases, the methods used for processing and analyzing biomedical signals are

derived from a modeling perspective based on statistical signal descriptions. The purpose of the signal processing methods ranges from reduction of noise and artifacts to extraction of clinically significant features. The course gives each participant the opportunity to study the performance of a

method on real, biomedical signals.

#### 5b. Prerequisites or Co-requisites: CS131 or CS141 or SW408, and MA126 or MA122, or permission of the instructor

#### 5c. Require/Elective/Selective Elective: Required

#### 6a. Specific Outcomes: After completing this course, students will have the ability to (ABET Criteria and Bloom’s Taxonomy levels in brackets):

* 1. Students will understand the fundamental concepts and principles of Digital Signal Processing. (1, Comprehension)
  2. Students will use the Matlab and/or Java to analyze and synthesize biomedical signals. (2, Application)
  3. Students analyze biomedical signals. (2, Analysis)
  4. Students synthesize biomedical signals. (2, Synthesis)
  5. Students will research and report (Oral and written) on a class of biomedical instruments. (3, b, c, Analysis, Synthesis)
  6. Students will demonstrate the use and application of MatLab/Java software in the above application. (2, Application)

#### 6b. This course supports student outcomes: “1,2,3”

#### Brief List of Topics:

* **Introduction, Why Digital?**
* **Programming Review**
* **Fourier Series/Transform, Impulse Response/Convolution**
* **Sampling – Representing the Analog world in a computer**
* **Discrete Fourier Transform and the FFT**
* **Laplace Transform and the z-Transform**
* **Discrete Number systems**
* **Discrete Convolution and Correlation**
* **Biomedical Applications**
  + Electrocardiograms/EEGs
  + Noise Reduction Techniques
  + Ultrasonic Imaging
  + Tomography
* **Design/Research/Project Topics:** 
  + ECG Analysis/Denoising using Wavelets: Teach us about wavelet decomposition and apply it to “denoising” example ECG data to make it easier for human diagnosis.
  + Ultrasonic Imaging in 3-D: Teach as about the processing of ultrasonic signals to provide 2-D images and use available 2-D data to develop 3-D images.
  + Tomographic Image processing (Catscan, MRI): Teach us about Tomography and its application in processing biomedical images.
  + Electromyography (EMC) signals and processing them to improve the signal to noise ratio.
  + Brain Signal (EEG) Analysis

#### This syllabus was prepared by: \_Jeffrey Denenberg\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_