The University of Texas at Tyler
Department of Electrical Engineering

EENG 53XX: Advanced Topics: Biosensors and Biosignal Processing

Syllabus

Catalog Description:

Advanced studies in Electrical Engineering in topics not covered in regularly scheduled graduate courses. May be repeated as content changes. A maximum of nine (9) hours may be used for graduate credit on the degree plan if topics vary.

Prerequisites: Consent of Instructor: Matrix Methods, Signal and Systems, Digital Signal Processing

Credits: 3 ( ) hours lecture, 0 hours laboratory per week)

Text(s): Eugene N Bruce, **Biomedical Signal Processing and Signal Modeling,** John Wiley & Sons, 2001
ISBN-13: 978-0471345404 ISBN-10: 0471345407

Additional Material: MATLAB Tools

Course Coordinator: Dr. Premananda Indic, Assistant Professor

Topics Covered: (paragraph of topics separated by semicolons)

Basic physiology, Bioelectric signals, basic biosensors, wearable sensors, bio-amplifiers, time-frequency analysis, ARMA models, Principal Component Analysis, Introduction to nonlinear systems and signals. Analysis of Electrocardiogram, electroencephalogram, activity, heart rate, galvanic skin response and temperature signals.

Evaluation Methods: (only items in dark print apply):

1. Examinations / Quizzes
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Learning Outcomes[1]: By the end of this course students will be able to:

1. Understand basic physiology and fundamentals of biosignal processing.
2. Understand the difference between stationary and nonstationary signals. The significance of nonstationarity in biomedical signals
3. Implement Time frequency Analysis of various biosignals
4. Modeling of biosignals using autoregressive and moving average models (ARMA)
5. Principal Component Analysis and signal reduction
6. Basic concept of nonlinear systems
7. Understand nonlinear signals
8. Utilizing MATLAB to analyze different biosignals.

9. Write laboratory reports with experimental data collected using wearable sensors demonstrating analytics and written communication skills.

[1]*Numbers in brackets refer to method(s) used to evaluate the course objective.*

Relationship to Program Outcomes (Student Learning Outcomes)[2]: This course supports the following Electrical Engineering Program Outcomes, which state that our students will:

1. **Breadth and Depth:** Students will be able to apply knowledge at a graduate level in two of the following areas: electronics, power systems, controls, advanced engineering mathematics, signal processing, communications, real-time systems, computer systems, electromagnetic and power electronics. [1,7]
2. **Modern Engineering Tools:** Students will be able to use modern engineering tools for analysis and design as applied to engineering problems. [6]
3. **Advanced Engineering Mathematics**: Students will be able to apply principles of advanced engineering mathematics including probability and statistics to engineering problems. [3,6]
4. **Systems Design**: Students will be able to apply systems design approaches including modeling and simulation of interacting sub-systems to complex engineering problems. [4, 5]
5. **Design Methods**: Students will be able to demonstrate application of design methodology by comparing and evaluating solutions to engineering problems.[8]
6. **Communication Skills**: Students will demonstrate effective oral, visual and written communication skills from a technical perspective. [9]

[2]*Numbers in brackets refer to course objective(s) that address the Program Outcome.*

Contribution to Meeting Professional Component: (in semester hours)

Mathematics and Basic Sciences:		hours
Engineering Sciences and Design:	3	hours
General Education Component:		hours

Prepared By: Premananda Indic, Assistant Professor Date: 2 February 2017

EENG 4350/5318: Biosensors and Biomedical Data Analysis

Fall 2019 Syllabus

Instructor Information:

Premananda Indic, PhD
Department of Electrical Engineering,
The University of Texas at Tyler
Office: RBN 2010,
Phone: 903-566-6208,
email:pindic@uttyler.edu (preferred)

Office Hours:

Monday	: 11:30PM to 12:00PM
Wednesday	: 11:30PM to 12:00PM
Additional Hours	: By appointment

Course Description:

The objective of this course is to study the Basic physiology, Bioelectric signals, basic biosensors, wearable sensors, bio-amplifiers, time-frequency analysis, ARMA models, Principal Component Analysis, Introduction to nonlinear systems and signals. Analysis of Electrocardiogram, electroencephalogram, activity, heart rate, galvanic skin response and temperature signals.

The primary student learning objectives are:

1. Understand basic physiology and fundamentals of biosignal processing.
2. Understand the difference between stationary and nonstationary signals. The significance of nonstationarity in biomedical signals
3. Implement Time frequency Analysis of various biosignals
4. Modeling of biosignals using autoregressive and moving average models (ARMA)
5. Principal Component Analysis and signal reduction
6. Basic concept of nonlinear systems
7. Understand nonlinear signals
8. Utilizing MATLAB to analyze different biosignals.
9. Write laboratory reports with experimental data collected using wearable sensors demonstrating analytics and written communication skills.

Recommended Textbook:

Eugene N Bruce, **Biomedical Signal Processing and Signal Modeling,** John Wiley & Sons, 2001. ISBN-13: 978-0471345404 ISBN-10: 0471345407

Students must bring their laptop with MATLAB installed. All the assignments/projects will be completed using MATLAB

Evaluation and Grading:

The course grade will be based on the following activities:

1. **Assignments (30%):**
   There will be six assignments and it should be submitted through Canvas using pdf or word format. No late submissions allowed. Collaboration on assignments is strongly encouraged, however expecting a disclaimer statement at the end of your assignments if you have discussed with the students in the class or someone outside. All resources, including materials obtained from internet should be properly acknowledged.

2. **Projects (40%):**
   There will be four projects as given in the outline. Students will complete these projects in class and no collaboration allowed.

3. **Midterm Exam (15%):**
   There will be a midterm exam of duration 3 hour as mentioned in the outline

4. **Final Exam (15%):**
   Final exam as per University Schedule

Course Outline:

Schedule	Topics	Assignments
Week 1: (August 26)	Review of Basic Concepts	Review Syllabus
Week 2: (September 2)	Laplace Transform, z-Transform and Fourier Transform Continuous time vs discrete time systems Time domain analysis	Assignment 1 due on 9/7/2019
Week 3: (September 9)	Frequency domain analysis Filters	Project 1 on 9/11/19
Week 4: (September 16)	Fourier Series and Fourier transform Sampling of continuous time signals	Assignment 2 due on 9/21/19
Week 5: (September 23)	Basic Physiology & Bioelectric Signals	Project 2 on 9/25/19
Week 6: (September 30)	Time Frequency Analysis	Assignment 3 due on 10/12/19
Week 7: (October 7)	Review of topics studied in Week 1 through Week 6	
Week 8: (October 14)	ARMA Models	Midterm on 10/16/19
Week 9: (October 21)	Sensors, bio-amplifiers	Assignment 4 due on 10/26/19
Week 10: (October 28)	Nonlinear signal analysis	Project 3 on 10/30/19
Week 11: (November 4)	ECG Analysis	Assignment 5 due on 11/09/19
Week 12: (November 11)	EEG Analysis	Project 4 on 11/13/16
Week 13: (November 18)	Activity, Heart rate and GSR analysis	
Week 14: (November 25)	Review	Assignment 6 due on 11/30/16
Week 15: (December 2)	Final Exam	