The University of Texas at Tyler
Department of Electrical Engineering

EENG 5318: Advanced Topics: Biosensors and Biomedical Data Analysis

Syllabus

Catalogue Description:

Advanced studies in Electrical Engineering in topics not covered in regularly scheduled undergraduate courses. May be repeated as content changes. A maximum of nine (9) hours may be used for undergraduate 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

Narayanaswamy, Ramaier, and Otto S. Wolfbeis. *Optical sensors: industrial, environmental and diagnostic applications.* Vol. 1. Springer Science & Business Media, 2004. (**supplementary**)

Yoon, Jeong-Yeol. *Introduction to biosensors: from electric circuits to immunosensors*. Springer Science & Business Media, 2012. (**supplementary**)

Additional Material:	MATLAB Tools
Course Coordinator:	Premananda Indic, PhD

Topics Covered: (paragraph of topics separated by semicolons)

Basic physiology, Bioelectric signals, basic biosensors, wearable sensors, bio-amplifiers, Biomedical signal analysis using Fourier transforms, Power Spectrum Analysis, ARMA models, 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. [1]
2. Understand the difference between stationary and nonstationary signals. The significance of nonstationarity in biomedical signals [1]
3. Modeling of biosignals using autoregressive and moving average models (ARMA) [2]
4. Basic concept of nonlinear systems [1]
5. Understand nonlinear signals [7]
6. Utilizing MATLAB to analyze different biosignals. [6]
7. 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. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics; [1,2,4]
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors; [3]
3. an ability to communicate effectively with a range of audiences; [7]
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts;
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives;
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions; [6]
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. [7]

[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, PhD Date: 27 May 2020

EENG 4350/5318: Biosensors and Biomedical Data Analysis

Fall 2021 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	: 9:30AM to 11:00AM
Wednesday	: 9:30AM to 11:00AM
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 24)	Review of Basic Concepts	Review Syllabus
Week 2: (August 31)	Laplace Transform, z-Transform and Fourier Transform Continuous time vs discrete time systems Time domain analysis	Assignment 1 due on 8/31/21
Week 3: (September 7)	Frequency domain analysis Filters	Project 1 on 9/7/21
Week 4: (September 14)	Fourier Series and Fourier transform Sampling of continuous time signals	Assignment 2 due on 9/14/21
Week 5: (September 21)	Basic Physiology & Bioelectric Signals	Project 2 on 9/21/21
Week 6: (September 28)	Time Frequency Analysis	Assignment 3 due on 9/28/21
Week 7: (October 5)	Review of topics studied in Week 1 through Week 6	
Week 8: (October 12)	ARMA Models	Midterm on 10/12/21
Week 9: (October 19)	Sensors, bio-amplifiers	Assignment 4 due on 10/19/21
Week 10: (October 26)	Nonlinear signal analysis	Project 3 on 10/26/21
Week 11: (November 2)	ECG Analysis	Assignment 5 due on 11/2/21
Week 12: (November 9)	EEG Analysis	Project 4 on 11/9/21
Week 13: (November 16)	Activity, Heart rate and GSR analysis	
Week 14: (November 30)	Review	Assignment 6 due on 11/30/21
Week 15:	**Final Exam**	As per University Schedule