FAU
FLORIDA ATLANTIC UNIVERSITY

NEW COURSE PROPOSAL
Graduate Programs

Department Computer & Elec. Eng. and Computer Sci

College College of Engineering and Computer Science

*(To obtain a course number, contact **erudolph@fau.edu**)*

UGPC Approval _____
UFS Approval _____
SCNS Submittal _____
Confirmed _____
Banner Posted _____
Catalog _____

Prefix EEE **Number** 5286	*(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)* **Lab Code**	**Course Title** Biosignal Processing
Credits *(Review Provost Memorandum)* 3 **Effective Date** *(TERM & YEAR)* Fall 2017	**Grading** *(Select One Option)* **Regular** ◉ **Sat/UnSat** ○	**Course Description** *(Syllabus must be attached; see Guidelines)* This course covers the generation of bioelectrical signals, their acquisition, modeling and analysis. Modeling and analysis tools cover adaptive filtering, time-frequency analysis, model-based spectral analysis, stochastic signals, and signal representation in orthogonal bases: wavelet transforms.

Prerequisites	**Corequisites**	**Registration Controls** *(Major, College, Level)*
EEL 4656 Analysis of Linear Systems or permission of instructor.	N/A	Graduates,Seniors (Eng.&Com. Sci, Or College of Science)

Prerequisites, Corequisites and Registration Controls are enforced for all sections of course

Minimum qualifications needed to teach course: Member of the FAU graduate faculty and has a terminal degree in the subject area (or a closely related field.)	**List textbook information in syllabus or here** Bioelectrical Signal Processing in Cardiac and Neurological Applications by Leif Sornmo and Pablo Laguna. Elsevier Academic Press, ISBN: 978-0-12-437552-9, 2005.
Faculty Contact/Email/Phone Behnaz Ghoraani/bghoraani@fau.edu/561-297-4031	**List/Attach comments from departments affected by new course** College of Medicine, Department of Biomedical Sciences College of Eng. and Comp. Sci, Department of Ocean and Mechanical Eng.

Approved by	***Date***
Department Chair _____	3/3/17
College Curriculum Chair _____	3/7/17
College Dean _____	3/10/17
UGPC Chair _____	
Graduate College Dean _____	
UFS President _____	
Provost _____	

Email this form and syllabus to UGPC@fau.edu one week before the UGPC meeting.

Department of Computer & Electrical Engineering
and Computer Science
Florida Atlantic University
Course Syllabus

1. Course title/number, number of credit hours	
Biosignal Processing EEE 5286	# of credit hours = 3
2. Course prerequisites, corequisites, and where the course fits in the program of study	
Prerequisites: EEL 4656 Analysis of Linear Systems or permission of instructor.	
3. Course logistics	
Term: Fall 2017 Location: TBD	
4. Instructor contact information	
Instructor's name *Office address* *Office Hours* *Contact telephone number* *Email address*	Behnaz Ghoraani, PhD Bldg. EE 96/ Room 319 TBD 561-297-4031 bghoraani@fau.edu
5. TA contact information	
TA's name *Office address* *Office Hours* *Contact telephone number* *Email address*	TBD
6. Course description	
This course covers the generation of bioelectrical signals, their acquisition, modeling and analysis. Modeling and analysis tools cover adaptive filtering, time-frequency analysis, model-based spectral analysis, stochastic signals, and signal representation in orthogonal bases: wavelet transforms. The physiology of electrical signal generation covers ionic transport in cellular membranes and propagation of electrical signals in cells and tissues. The range of biomedical signals covered includes such common signals as the electroencephalograms, evoked potentials, electromyograms, electrocardiograms. The students write MATLAB codes to perform common signal analysis such as filtering, autocorrelation and covariance, Fourier-based spectral analysis, the short-time Fourier transform, and noise reduction.	
7. Course objectives/student learning outcomes/program outcomes	
Course objectives	This course provides a comprehensive overview of techniques of processing bioelectrical signals. It is problem-based and programming oriented. Students are expected to code in MATLAB at a level where they can use programming to verify and demonstrate concepts. Demonstration of work will be done with synthetically generated waveforms and real data.

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8. Course evaluation method

3 MATLAB-based assignments (20% each): 60% Project: 40%	For the project, the students will identify a scientific article for review and implementation. The students will prepare a 10-page technical report to discuss the problem in the paper, the methods applied, implementation of the method in the paper, and their results. Also the students will propose a new approach to address the problem and compare their results with the methods found in the paper. The students will deliver a 15-minutes presentation and present their final work to the class for further discussions with their peers. The project will be implemented in four phases (I-proposing a paper. II-Review of the paper. III-Final Implementation. IV. Final report and presentation)

9. Course grading scale

Grading Scale:
90 and above: "A", 87-89: "A-", 83-86: "B+", 80-82: "B", 77-79 : "B-", 73-76: "C+", 70-72: "C", 67-69: "C-", 63-66: "D+", 60-62: "D", 51-59: "D-", 50 and below: "F."

10. Policy on makeup tests, late work, and incompletes

Incomplete grades are assigned only if there is a solid evidence of medical or otherwise serious emergency situation incomplete grades will not be given.

Late assignment submissions will not be graded and the student will receive a ***zero*** for that assignment. There are no make ups for the assignments.

The following applies to the final project: after 1 day, the students will lose 25% and after 2 days, 50% of marks. The student will receive a ***zero*** after the 2nd day of due date.

11. Special course requirements

N/A.

12. Classroom etiquette policy

FAU course management system (Canvas) will be the official communication tool between the instructor and the students, and it is the student's responsibility to regularly check the course shell for updates and announcements. This includes unforeseen changes to assignment/project deadlines.

It is the student's responsibility to inform the professor, within the first week of class, of any conflict with important course dates. No accommodation will be made if these conflicts are not brought to our attention within the first week.

University policy requires that in order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular phones and laptops, are to be disabled in class sessions.

Students are strongly encouraged to ask questions during class. You may not use a PDA, PPC, laptop, netbook or other computer, IPOD or similar device in-class or during quizzes or exams. Cellular/PCS telephones, pagers, PDAs, etc. must be turned-off or put in vibrate mode during class. If your device disrupts the lecture, you may be asked to leave immediately. Upon a second offense, you will need to explain your actions to the CEECS Department Chair before being allowed to return. If you require an exception to this policy, please see me before creating a disturbance.

Although you are EXPECTED and ENCOURAGED to utilize a study-group, individual and original efforts are expected for all exams, quizzes and homework assignments except when otherwise stated. **Cheating in any form will not be tolerated. Students giving and/or receiving assistance on an exam will be given a grade of zero for the exam. Furthermore, the incident will be reported per the College policy on Academic Dishonesty.**

13. Disability policy statement

In compliance with the Americans with Disabilities Act Amendments Act (ADAAA), students who require reasonable accommodations due to a disability to properly execute coursework must register with Student Accessibility Services (SAS)—in Boca Raton, SU 133 (561-297-3880); in Davie, LA 131 (954-236-1222); or in Jupiter, SR 111F (561-799-8585) —and follow all SAS procedures.

14. Honor code policy

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and place high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. See University Regulation 4.001 at www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf

15. Required texts/reading

Bioelectrical Signal Processing in Cardiac and Neurological Applications by Leif Sornmo and Pablo Laguna. Elsevier Academic Press, ISBN: 978-0-12-437552-9, 2005.

16. Supplementary/recommended readings

R.M. Rangayyan, Biomedical Signal Analysis: A Case-Study Approach, 1st Edition IEEE and Wiley, 2002

A.V. Oppenheim and A.S. Willsky with S. Hamid, Signals and Systems, 2nd Edition, Prentice Hall, 1996.

A.V. Oppenheim and R.W. Schafer with J. Buck, Discrete-Time Signal Processing, 3rd Edition, Prentice Hall, 2010.

Demonstration of work will be done with synthetically generated waveforms and real data, which is available from the public database: http://www.physionet.org/

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Course Syllabus

17. Course topical outline, including dates for exams/quizzes, papers, completion of reading

Weekly Schedule	Topics
Week 01	Basics of Bioelectrical Signals – Chapter 1 – On the cellular level – On the body surface – Bioelectrical signals – Signal acquisition and analysis – Databases/simulation
Week 02	The Electrocardiogram Signal Processing – Chapter 6 – Electrical activity of the heart – Generation and recording of an ECG (Depolarization/repolarization, recording techniques, ECG waves and time intervals) – Different types of heart rhythm – Heart beat morphologies – Noise and artifacts – Clinical applications (resting ECG, Intensive care monitoring, ambulatory monitoring, stress test, high-resolution ECG)
Week 03	ECG Signal Processing – Chapter 7 – Baseline wander filtering (linear filtering, time-varying/time, Polynomial fitting) – Powerline interface (linear/non-linear filtering, estimation subtraction) – Muscle noise filtering **Assignment #1**
Week 04	Continue ECG Signal Processing – Chapter 7 – QRS detection – Wave delineation – Data compression **Project phase I**
Week 05	Evoked Potentials – Chapter 4 – Evoke potential modalities – Noise characteristics & noise reduction methods (ensemble averaging, linear filtering) – Single trial analysis by Basis functions (orthogonal expansion, Karhunen-Loeve expansion, modeling with damped sinusoids)
Week 06	Continue Evoked Potentials – Chapter 4 – Adaptive filtering using Basis functions – Instantaneous LMS algorithm, block LSM algorithm
Week 07	Continue Evoked Potentials – Chapter 4 – Wavelets transform – Multi-resolution signal analysis – Denoising using wavelet filtering

	Assignment #2
Week 08	The Electroencephalogram (EEG) – Chapter 2 – The nervous system (neurons, the cerebral cortex) – The EEG signals (Rhythms and waveforms, categorization of EEG activity) – Recording techniques – Applications of EEG (epilepsy, sleep disorder, brain-computer interface) **Project phase II**
Week 09	EEG Signal Processing- Chapter 3 – Modeling the EEG signals (deterministic and stochastic signals, stochastic models, nonlinear modeling of the EEG) – Artifacts in EEG (characteristics, processing, cancellation)
Week 10	Continue EEG Signal Processing- Chapter 3 – Non-parametric spectral analysis (Fourier-based power spectrum analysis/ spectral parameters) – Model-based spectral analysis
Week 11	Continue EEG Signal Processing- Chapter 3 – EEG segmentation – Spectral measure error – The Periodogram approach – The whitening approach **Assignment #3**
Week 12	Continue EEG Signal Processing- Chapter 3 – Joint time-frequency analysis – The short-time Fourier transform – The ambiguity function – The Wigner-Ville distribution – Cohen's class time-frequency distributions **Project phase III**
Week 13	The Electromyogram -Chapter 5 – The electrical activity of muscles (action potentials and motor units) – Recording of myoelectric signals – EMG applications – Amplitude estimation using signal model and ML estimation – Spectral analysis of the EMG signal
Week 14	Continue the Electromyogram -Chapter 5 – Conduction velocity estimation (two-channel and multi-channel time delay estimation) – Modeling and intramuscular EMG (the MUAP train amplitude and power spectrum) – Intramuscular EMG signal decomposition (feature extraction and clustering)
Week 15	Students' project presentations **Project Phase IV**

From: Janet Robishaw
Sent: Thursday, February 16, 2017 11:34 AM
To: Behnaz Ghoraani
Cc: Nurgun Erdol; Mihaela Cardei
Subject: FW: Request for a new course approval - Biosignal processing,

Hi Behnaz,

After checking with our Graduate Office, no overlap was noted. We recommend approval and extend our best wishes towards a successful launch of your new course.

Best Regards,

Janet

Janet Robishaw, PhD
Interim Senior Associate Dean for Research
Chair and Professor, Department of Biomedical Science@fau
Florida Atlantic University
777 Glades Road, BC71-34
Boca Raton, FL 33431
(561) 297-4399
jrobishaw@health.fau.edu

From: Marc Kantorow
Sent: Thursday, February 16, 2017 10:56 AM
To: Janet Robishaw <jrobishaw@health.fau.edu>
Subject: Re: Request for a new course approval - Biosignal processing,

Hi Janet,

At first glance looks like an OK specialty course and does not compete with any of our course listings.

I see no objection.

Thanks, Marc

Marc Kantorow, Ph.D. FARVO
Assistant Dean of Graduate Programs
Professor of Biomedical Science
Charles E. Schmidt College of Medicine
Florida Atlantic University
777 Glades Rd. BC71 RM202
Florida Atlantic University
Boca Raton, FL 33431
561-297-2910 (office)
561-297-3806 (lab)

mkantoro@fau.edu

From: Janet Robishaw <jrobishaw@health.fau.edu>
Date: Thursday, February 16, 2017 at 10:35 AM
To: marc kantorow <mkantoro@health.fau.edu>
Subject: FW: Request for a new course approval - Biosignal processing,

Hi Marc,

Would you please review this course and let me know your thoughts on this course ?

Best,

Janet

Janet Robishaw, PhD
Chair and Professor, Department of Biomedical Science
Florida Atlantic University
777 Glades Road, BC71-34
Boca Raton, FL 33431
(561) 297-4399
jrobishaw@health.fau.edu

From: Behnaz Ghoraani
Sent: Tuesday, February 14, 2017 12:58 PM
To: Janet Robishaw <jrobishaw@health.fau.edu>
Cc: Nurgun Erdol <erdol@fau.edu>; Mihaela Cardei <mcardei@fau.edu>
Subject: Request for a new course approval - Biosignal processing,

Dear Dr. Robishaw,
The Department of Computer & Electrical Engineering and Computer Science (CEECS) is proposing a new course: EEE 5286 – Biosignal Processing. Please see the attached syllabus for this course.
We need your approval that Department of Biomedical Sciences has no objection to this new course proposal. Could you please review the syllabus and email me your decision on approval at your earliest convenience?

Thanks and regards,
Behnaz

Behnaz Ghoraani, Ph.D., SMIEEE
Faculty Fellow, Institute for Sensing and Embedded Network Systems Engineering
Assistant Professor, Department of Computer & Electrical Engineering and Computer Science,
Building EE 96, Office: 319
Phone: 561-297-4031
Florida Atlantic University, Boca Raton, FL 33431, USA
website: http://biomedsignal.com

From: Tsung-Chow Su <su@fau.edu>
Date: Friday, February 17, 2017 at 5:05 PM
To: Behnaz Ghoraani <bghoraani@fau.edu>
Subject: Re: Request for a new course approval - Biosignal processing,

Dear Behnaz,

Thanks for your email. Our faculty believe that the course you proposed is a great course. OME will support it.

Best

Joe

Sent from my iPhone

On Feb 14, 2017, at 1:00 PM, Behnaz Ghoraani <bghoraani@fau.edu> wrote:
Dear Dr. Su,
The Department of Computer & Electrical Engineering and Computer Science (CEECS) is proposing a new course: EEE 5286 – Biosignal Processing. Please see the attached syllabus for this course.
We need your approval that Department of Ocean and Mechanical Engineering has no objection to this new course proposal. Could you please review the syllabus and email me your decision on approval at your earliest convenience?

Thanks and regards,
Behnaz

Behnaz Ghoraani, Ph.D., SMIEEE
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