FLORIDA ATLANTIC UNIVERSITY

NEW COURSE PROPOSAL
Undergraduate Programs

Department Electrical Engineering and Computer Science

College Engineering and Computer Science

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

UUPC Approval 2-28-22
UFS Approval _____
SCNS Submittal _____
Confirmed _____
Banner Posted _____
Catalog _____

Prefix BME

Number 4523

(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)

Lab Code

Type of Course: Lecture

Course Title: Introduction to Biosignal Processing

Credits *(Review Provost Memorandum)*: 3

Effective Date *(TERM & YEAR)*: Fall 2022

Grading *(Select One Option)*: Regular ◉ Pass/Fail ○ Sat/UnSat ○

Course Description *(Syllabus must be attached; Syllabus Checklist recommended; see Guidelines)*

See syllabus attached for course description information.

Prerequisites, with minimum grade*

EEL 3502 Signals and Digital Filter Design with minimum grades of "C" or permission from instructor

Corequisites

Registration Controls *(Major, College, Level)*

Default minimum passing grade is D-.** **Prereqs., Coreqs. & Reg. Controls are enforced for all sections of course

WAC/Gordon Rule Course

○ Yes ◉ No

WAC/Gordon Rule criteria must be indicated in syllabus and approval attached to proposal. See WAC Guidelines.

Intellectual Foundations Program (General Education) Requirement *(Select One Option)*

None

General Education criteria must be indicated in the syllabus and approval attached to the proposal. See GE Guidelines.

Minimum qualifications to teach course

PhD in CS, CE or EE or a related field

Faculty Contact/Email/Phone

Hanqi Zhuang, zhuang@fau.edu,5612973413

List/Attach comments from departments affected by new course

Approved by	***Date***
Department Chair	11/8/21
College Curriculum Chair Hongbo Su	
College Dean	2-12-22
UUPC Chair Ehlyn Williams	2-28-22
Undergraduate Studies Dean Daniel Messoff	2-28-22
UFS President	
Provost	

Digitally signed by Hongbo Su
DN: CN=Hongbo Su, O=FAU, OU=FAU, E=suh@fau.edu, C=US
Reason: I am the author of this document
Location: your signing location here
Date: 2022.02.10 15:31:16-05'00'
Foxit Reader Version: 10.1.1

Email this form and syllabus to mjenning@fau.edu seven business days before the UUPC meeting.

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

1. Course title/number, number of credit hours	
Introduction to Biosignal Processing -BME 4523	3 credit hours
2. Course prerequisites, corequisites, and where the course fits in the program of study	
Prerequisites: EEL 3502 Signals and Digital Filter Design with minimum grades of "C" or permission from instructor	
3. Course logistics	
Term: TBD *Class location and time:*	
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.
Student learning outcomes & relationship to ABET 1-7 outcomes	TBD
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.

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 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 EECS 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. Attendance policy statement

Students are expected to attend all of their scheduled University classes and to satisfy all academic objectives as outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of non-attendance. After two full weeks of face-to-face instruction with consecutive 'no show' of any students in person in the classroom, the modality of this course section may be changed to remote instruction only at the discretion of the university.

Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations, or participation in University-approved activities. Examples of University-approved reasons for absences include participating on an athletic or scholastic team, musical and theatrical performances, and debate activities. It is the student's responsibility to give the instructor notice prior to any anticipated absences and within a reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the opportunity to make up work missed without any reduction in the student's final grade as a direct result of such absence.

14. 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) and follow all SAS procedures. SAS has offices across three of FAU's campuses – Boca Raton, Davie and Jupiter – however disability services are available for students on all campuses. For more information, please visit the SAS website at www.fau.edu/sas/.

15. Counseling and Psychological Services (CAPS) Center

Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider utilizing FAU's Counseling and Psychological Services (CAPS) Center. CAPS provides FAU students a range of services – individual counseling, support meetings, and psychiatric services, to name a few – offered to help improve and maintain emotional well-being. For more information, go to http://www.fau.edu/counseling/.

16. Code of Academic Integrity policy statement

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 an unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001.

17. 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.

18. 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/

19. Course topical outline (and associated readings)

Weekly Schedule	Topics
Week 01	Basics of Bioelectrical Signals – Chapter 1 – 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) – 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
Week 04	Continue ECG Signal Processing – Chapter 7 – QRS detection – Wave delineation – Data compression
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
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)
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
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
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