

## **Biosignals and Systems**

### **BME 3508**

**Time:** Period 3 (09:35 AM - 10:25 AM) Mondays, Wednesdays, Fridays

**Location:** NZH 0112

**Academic Term:** Spring 2024

#### ***Instructor***

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Office Location: BMS J285

Office Hours: By appointment

#### ***Teaching Assistant***

Yujun Chen

#### ***Course Description***

Basic theory and techniques of biosignals and systems. Topics include sampling, random biological signals, signal averaging, Fourier analysis and filtering.

#### ***Course Pre-Requisites / Co-Requisites***

Pre-Requisites: MAC2313 with minimum grade of C.

#### ***Course Objectives***

This course will acquaint the student with all the major concepts and methods in the analysis of biosignals and systems.

#### ***Materials and Supply Fees***

N/A.

#### ***Required Textbooks and Software***

*Signal Processing for Neuroscientists* by Wim van Drongelen, Academic Press, 2011.

#### ***Recommended Reading***

*Probability and statistical inference* by Hogg and Tanis (6<sup>th</sup> edition). *The analysis of time series: An introduction* by Chatfield (6<sup>th</sup> edition)

#### ***Course Content/Schedule***

Week 1: Introduction. Acquisition of biosignals: discrete sampling in amplitude and time, Nyquist-Shannon sampling theorem, anti-aliasing filter

Weeks 2-5: Random biological signals: theoretical considerations: stochastic processes, univariate and bivariate biological time series, Matlab based simulation and analysis

Week 6: Event-related response and signal averaging: theoretical basis of averaging, Matlab based simulation and analysis

Weeks 7-10: Fourier analysis of deterministic and random biological signals: Fourier theorem, real and complex Fourier analysis, spectral analysis of univariate and bivariate biological time series

Week 11: Linear systems and Laplace transform: LTI systems, Laplace transform, z-transform

Week 12: Filtering theory and applications to biological problems: physical models of filters, IIR and FIR filters

Weeks 13-14: Nonlinear models and methods: discrete maps, concepts of deterministic chaos, characterization of nonlinear time series, Matlab based simulation and analysis

**Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance is strongly encouraged. Students are expected to take careful class notes.

**Evaluation of Grades**

50% homework, 25% midterm exam and 25% final exam.

**Grading Policy**

A: 95-100, A-: 90-94.99, B+: 85-89.99, B: 80-84.99, B-: 75-79.99, C+: 70-74.99, C: 65-69.99, C-: 60-64.99.

**Relation to Program Outcomes (ABET):**

| ABET Outcome  | Coverage* |            |
|---|-----------|------------|
| 1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics  | High      | Reinforced |
| 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                   | Medium    | Introduced |
| 3. an ability to communicate effectively with a range of audiences  |           |            |
| 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  |           |            |
| 7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies   |           |            |

**COVID-19**

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.

- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email [covid@shcc.ufl.edu](mailto:covid@shcc.ufl.edu)) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

### ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

### ***Campus Resources:***

#### *Health and Wellness*

##### **U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

**Sexual Assault Recovery Services (SARS)**  
Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

#### Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.