

BME360/361 Biomeasurement & Lab (3+1 credits) MWF11 Engineering 045 F2019

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| week | date | lecture topics | Reference |
|------|-------------------------|---|--------------------|
| 1 | 09/04 09/06 | introduction: biomeasurement, embedded system design hardware/software systems for embedded design | handout handout |
| 2 | 09/09 09/11 09/13 | overview of the PIC18F452 microprocessor programming languages: assembly and C++ electrocardiogram (ECG): anatomy & physiology | handout handout |
| 3 | 09/16 09/18 09/20 | electrocardiogram (ECG): instrumentation C programming: "for" loops, "while" loops, "switch" timer for providing periodical timing references | handout |
| 4 | 09/23 09/25 09/27 | interrupts simulation of ECG signals analog-to-digital conversion, digital-to-analog conversion | handout |
| 5 | 09/30 10/02 10/04 | unsigned binary vs. 2's complement backward difference to approximate derivative Exam #1 | |
| 6 | 10/07 10/09 10/11 | serial-parallel interface (SPI) and LCD display basics of operational amplifiers (op amps) analog circuit design with op amps | handout |
| 7 | 10/15 10/16 10/18 | (Tuesday) instrumentation amplifiers ECG amplifier circuit introduction to real-time digital filters | handout |
| 8 | 10/21 10/23 10/25 | low-pass and high-pass filters a 60 Hz notch filter introduction to morphological filters | handout |
| 9 | 10/28 10/30 11/01 | median filter and C++ implementation digital QRS detection Exam #2 | handout |
| 10 | 11/04 11/06 11/08 | the multiplication of backward differences (MOBD) algorithm C++ implementation of the MOBD algorithm design of a heart rate meter | handout |
| 11 | 11/11 11/13 11/15 | (No class. Veterans' Day) introduction to digital signal processing, Nyquist-Shannon sampling theorem Youtube: Z-transform and discrete Fourier transform | handout |
| 12 | 11/18 11/20 11/22 | finite-impulse-response (FIR) & infinite-impulse-response (IIR) filters blood pressure measurement: non-invasive blood pressure measurement: invasive | online handout |
| 13 | 11/25 11/27 11/29 | blood pressure measurement: frequency characteristics No class (Thanksgiving) No class (Thanksgiving) | handout |
| 14 | 12/02 12/04 12/06 | (Sun teaches EGR 105. No class) summary review of the PIC program conclusions | |
| 15 | 12/9 12/19 | review Thursday 9:30 - 11:00 am Exam #3 | |

Grading: Exam #1 (33%), Exam # 2 (33%), Exam # 3 (34%).

BME 360/361 Biomeasurement & Labs

Office Hours: (by appointment, email yingsun@uri.edu)

Monday: 10:30–11:00 am, 12:00–1:00 pm
Wednesday: 10:30–11:00 am, 12:00–2:00 pm
Friday: 10:30–11:00 am, 12:00–1:00 pm

Textbook (recommended):

Medical Instrumentation: Application and Design. 4th ed., edited by Webster JG.
ISBN-13: 978-8126553792; ISBN-10: 8126553790
(This book is also the recommended textbook for BME 362 Biomedical Instrumentation.)

There is no required textbook.

Student Outcomes – Accreditation Board for Engineering and Technology (ABET)

BME 360

- 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- 2: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- 6: an ability to identify, formulate, and solve engineering problems.

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- 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.
- 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.

Generalized Learning Outcomes

Conceptions – signal-to-noise ratio, hardware-software tradeoff, digital-analog tradeoff, system integration
Applications – ECG, blood pressure, digital filters, detection algorithms, design process
Skills – electronics, embedded systems, C++ programming, multidisciplinary teamwork

BME 361 Labs (BME Lab is located in Engineering room 110.)

- LAB 1. Introduction to PIC18F452 and MPLab: Binary Counter
- LAB 2. ECG Simulation
- LAB 3. Echo and Derivative Programs
- LAB 4. Implementation of Various Modes and LCD Display
- LAB 5. Introduction to Soldering: ECG Printed Circuit Board
- LAB 6. Digital Filters: Low Pass, High Pass, Median, 60 Hz Notch
- LAB 7. QRS Detection
- LAB 8. Heart Rate Meter

Students with Disabilities

Any student with a documented disability is welcome to contact me as early in the semester as possible so that we may arrange reasonable accommodations. As part of this process, please be in touch with Disability Services for Students Office in Memorial Union, room 330 or phone 874-2098.