Western University
School of Biomedical Engineering

BME 3201A- "Fundamentals of Biomedical Engineering Design"

COURSE OUTLINE – Intersession May 2019

CALENDAR DESCRIPTION:

The objective of this course is to develop design skills and tools used in Biomedical Engineering. Integration of the engineering and life sciences will be illustrated by presenting design principles for medical devices and systems. Emphasis will be placed on engineering design for the cardiovascular and musculoskeletal systems.

COURSE INFORMATION:

Instructor:	Prof. Emily Lalone Room: TEB 353 Email: emily.lalone@uwo.ca
Lectures:	Mon (10-1), Thurs (10-1) (location) TBD
Tutorials:	Tu 1-3 (location) TBD
Teaching Assistant:	TBD

PREREQUISITES:

Engineering program must have completed the entire first year program in Engineering, with no outstanding credits to be taken, and have a Year Weighted Average (YWA) of at least 80% and permission of the School of Biomedical Engineering.

ACCREDITATION UNITS:

20% Engineering Science, 80% Engineering Design.

TOPICS:

Introduction into BME design of devices, systems and processes. An overview of fundamental design tools and product definition will be covered. Human factors such as anthropometric design, hardware and software elements in human factors will also be covered. Biomaterials and materials testing and the design of devices and systems in this field will be overviewed. This course will also cover regulatory and standards related to medical devices as part of Health Canada and the FDA. Engineering design of the cardiovascular and musculoskeletal systems will also be covered along with an overview of relevant anatomy and physiology. It is understood that this is an entry level course in the area of biomedical engineering which focuses on the design process related to biomedical engineering devices, systems and processes.

COURSE OBJECTIVES:

Upon successful complete of this course, students will develop skills necessary for biomedical engineering design and will be able to apply these skills to analyse and solve biomedical engineering design problems.

REQUIRED ATTRIBUTES IN THE ENGINEERING PROFESSION:

1. **Problem Analysis**: An ability to use appropriate engineering and life sciences (anatomy/physiology) knowledge and skills to identify, formulate, analyse and solve complex engineering problems.
2. **Design**: An ability to design solutions for complex, open-ended biological engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to regulatory and standards related to Health Canada and the FDA.
3. **Group work**: An ability to design devices processes and components that are related to biological (anatomy, physiology) based problems. This will require

students to work in a very multidisciplinary environment and so proficiencies in both the engineering and biological life sciences will be required.

4. **Ethics and Equity**: As biomedical design is design of devices, processes or systems that will be used with living creatures, regulatory considerations will be paramount to ensure safety. An ability to apply professional ethics, accountability and equity.

SPECIFIC LEARNING OBJECTIVES:

1. Biomedical Engineering Design (Design of Biomedical Devices and Systems)
    a. What is Biomedical Engineering Design
    b. What might be designed? (Biomedical Systems/Biomedical Processes)
    c. What are the Essentials of BME Design?
    d. BME Design in an Industrial Context
    e. Case Study
2. Essentials of Engineering Design Processes for BME: **Recognition of Need**
3. Essentials of Engineering Design Processes for BME: **Problem Definition**
4. Critical Design Concepts for BME
    a. Human Factors Process
    b. FDA, CE Mark and Health Canada Regulation (Devices and Non-Devices)
    c. Drug Testing Guidelines
    d. Medical Devices and Classification
    e. Testing Animals and in Humans/Ethics
5. Essentials of Engineering Design Processes for BME: **Information Gathering and Research**: Engineering Design of Musculoskeletal Systems
    a. Biomechanics of Musculoskeletal System
    b. Biomechanics of Human Movement
    c. Bone Mechanics
    d. Biomaterials for Musculoskeletal System
    e. Technology and Disabilities
    f. Applied Universal Design
    g. Design of Artificial Limbs/Hands
    h. Design of Orthopedic Implants
6. Essentials of Engineering Design Processes for BME: **Generation of Concepts**
7. Essentials of Engineering Design Processes for BME: Information Gathering and Research: Rehabilitative Engineering
    a. Major activities in Rehabilitation Engineering
    b. Principles of Assistive Technology Assessment
    c. Principles of Rehabilitation Engineering –Key Engineering and Ergonomic Principles
    d. Seating Biomechanics and Systems
    e. Wheelchair Transportation Safety
    f. Assistive Devices for Hearing Impaired and People who are Blind
8. Essentials of Engineering Design Processes for BME: **Evaluation of Concepts/Prototyping and Construction Testing/Detailed Design**
9. Essentials of Engineering Design Processes for BME: **Design Communication**

3 lecture hours, 2 tutorial hours, half course

TEXT: There is no required textbook for this course, however suggested texts are as follows: *Biomedical Engineering and Design Handbook (Volume 1&2)* (M. Kutz) and *Design of Biomedical Engineering Devices and Systems* (P. King) and *Introduction to Rehabilitation Engineering* (Cooper)

TUTORIAL: Students are expected to attempt relevant questions assigned in class during tutorial.

DESIGN PROJECT: Further details will be provided.

TIMETABLE: See attached timetable.

EXAMINATIONS

1, 3 hour closed book final exam June 21, 2019 (Time and Location) TBD

UNITS: S.I. units will be used.

EVALUATION: The final grade is computed as follows:

Design Project: 50% (Design notebook: 5%, Recognition of Need: 5%, Project Proposal: 5%, SOTA, 8%, Concept Generation Map: 5%, Peer assessment of status report: 2%, Final Poster: 10%, Final Write up: 8%)

Final Exam (All topics, 1-8): 50%

If a minimum mark of 50% is not obtained on the final examination, the student cannot receive a final mark greater than 48%.

ENGLISH: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests and examinations for the improper use of English. Additionally, poorly written work with the exception of final examinations may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

ATTENDANCE: Design notebooks (5%) will be marked in each tutorial and therefore attendance will be monitored. Please email the instructor/TA if you are absent. Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

CHEATING: University policy states that cheating, including plagiarism, is a scholastic offense. The commission of a scholastic offence is attended by academic penalties which might include expulsion from the program. If you are caught cheating, there will be no second warning. (see Scholastic Offence Policy in the Western Academic Calendar).

SSD: *Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.*

NOTE: The above topics and outline are subject to adjustments and changes as needed. Students who have failed an Engineering course (ie.<50%) must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.