King Saud University
College of Applied Medical Sciences
Department of Biomedical Technology
BMT338-Introduction to Biomedical Engineering Design 2 (2-0-0)

Current Instructor: Prof. H.S. Ranu, Fellow ASME
Course Coordinator: Prof. H.S. Ranu
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Textbook(s) and/or Other Required Materials:
Primary: Biomedical Engineering Design by Prof. H.S. Ranu

Course Description (catalog): This course continues the coverage of a Review of some fundamental concepts in Biomedical Engineering Design related to Medical Devices, and Orthopaedica Implants

Prerequisites: BMT 337 and BMT 232
Co-requisite: None
Course Type: Mandatory

Course Learning Outcomes: Upon completing BMT338, students should be able to:
1. Understand the broad meaning of design and its specific application to bioengineering.
2. Discern the main parameters that are addressed to design a safe orthotic and prosthetic including the stresses developed following isolated and combined loading conditions and the suitable failure criteria used.
3. Be familiar with the fundamental concepts in stress, strain, young's modulus of different materials and then using them in their medical devices design
4. Address different design concepts and use the strain gage technology and force platforms to estimate force and stress levels and carry out the design of crutches, foot insoles and implants accordingly.
5. Apply the numerical approaches like finite element analysis to validate simple design problems.

Student Outcomes Covered by Course:
a. an ability to select and apply the knowledge, techniques, skills, and modern tools of biomedical technology to include the application of circuit analysis, analog and digital electronics, microcomputers, biomechanics, biomedical instrumentation systems, and safety in the building, testing, operation, and maintenance of biomedical equipment.
Understanding the fundamental concepts in biomedical engineering design and specifically apply it to biomechanics and more particularly prosthetics and orthotics
b. an ability to select and apply a knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to building, testing, operation, and maintenance of biomedical equipment and the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of biomedical systems.

Combine the application of the knowledge of engineering and biological sciences in building simple devices or systems dedicated to replace, support or correct the function of a human member.

c. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.

d. an ability to analyze, design, and implement biomedical systems, components or processes for broadly-defined engineering technology problems appropriate to program educational objectives.

Students realize the importance of some components such as force and pressure transducers, strain gauges and EMG devices and use their output as parameters for the intended design

e. an ability to function effectively as a member or leader on a technical team.

Develop personal and social responsibility while working in a team through the preparation of a project report on a selected biomaterials topic.

f. an ability to identify, analyze, and solve broadly-defined biomedical technology problems.

g. an ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature.

Student will improve their written, oral and communication skills in general by making a deep literature search to cover a selected topic in bioengineering design. In addition to a well-structured report, students will have to make a concise presentation on the matter and lead a short discussion session.

h. an understanding of the need for and an ability to engage in self-directed continuing professional development.

i. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.

j. a knowledge of the impact of engineering technology solutions in a societal and global context and an understanding of the clinical application of biomedical equipment.

k. a commitment to quality, timeliness, and continuous improvement.

Major Topics covered and schedule in weeks:

1. A Review of some fundamental concepts in biomedical engineering design
2. Design of plates for fracture fixation
3. Design of Vascular Prosthesis: Dacron (Knitted), Hydrogels, Breast Implants (Silicone)
4. Design of orthotics and prosthetics
5. Ergonomic considerations in design and examples of ‘good’ ergonomics
6. Case studies in biomedical engineering design - personal experience in design
7. Triaxial load cells development hardware, bioinstrumentation, data collection and analysis
8. Use of Finite Element Modeling in Bioengineering systems e.g. interface between bone and implant and other materials analysis
9. CAD/CAM uses in design
10. Design aspects of human spine loading analysis including finite element modeling
11. Biomedical Engineering Design Class Presentations for each group