King Saud University
College of Applied Medical Sciences
Biomedical Technology Department

BMT438: Biomechanics of the musculoskeletal system and rehabilitation 2 (2-0-0)

Current Instructor: Dr Mohamed Zoubir Bendjaballah
Course Coordinator: Dr Mohamed Zoubir Bendjaballah
Coordinator's email: bendja@ksu.edu.sa

Textbook(s) and/or Other Required Materials:

Basic Biomechanics of the Musculoskeletal System, M. Nordin and V. Frankel. Lippincott Williams & Wilkins, 3rd Edition, 2001.

Course Description (catalog):
This course covers more advanced concepts and topics in biomechanics and addresses more precisely the musculoskeletal system and its components namely; bone, articular cartilage, ligaments, tendons and muscles. The composition and structure of those connective tissues, at macroscopic and microscopic levels and the relationship with their respective materials properties as well as the rupture mechanisms is also covered. Viscoelasticity is deeply addressed in this topic particularly for ligaments to see how the creep response become valuable in correcting some skeletal deformities. The fracture mechanisms of bone under various loading conditions are tackled as well as the various fixation techniques that achieve the required fracture stability and bone healing.

Prerequisites: BMT228-Introduction to Biomechanics
Co-requisite: None

Course Type: Mandatory

Course Learning Outcomes:
The global content of the course will:

- Introduce students to some advanced concepts of biomechanics that deal specifically with musculoskeletal system.
- Acquaint students with the force-motion relationships within the musculoskeletal system and the various techniques to understand them.
- Help future physical therapist understand the mechanisms of bone fracture and the different bone fixation devices and methods commonly used to satisfy the fracture stability and healing requirements.
- Help future physical therapist understand the mechanisms of passive structure rupture. Explain the theoretical basis behind clinical test commonly used for the assessment of ligament integrity/disruption either partial or total.

Student Outcomes Covered by Course:

a- an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;

b- an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;

→ Students apply knowledge in mathematics and engineering to evaluate the torsional and bending strength in bone in its normal than abnormal conditions. They are also able to estimate the average internal stresses in tissues and compare it with the ultimate stress values under various loading conditions.

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

→ Students are able to conduct test to assess for the strength of biologic tissues in intact and altered conditions. They are also able to assess for integrity/disruption of specific ligaments, interpret results and improve processes for particular subject conditions

d- an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;

---

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

---

f- an ability to identify, analyze, and solve broadly-defined engineering 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;

---

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

Students explore the efficiency of engineering technology principles in predicting for instance the mechanisms of injury for biologic tissues. Some engineering technology solutions following injuries such as bone fixation devices, total joint replacements and cruciate replacement are addressed.

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

Major Topics covered and schedule in weeks:

1. Basic Terminology and Concepts
2. Free Body Diagrams (FBD), application of 'FBD' to human joints
3. Bone composition and structure
4. Biomechanical behavior of bone and loading modes; tension, compression, shear, bending, torsion and combined loading
5. Stress concentration in bone following surgical procedures (Biopsies)
6. Biomechanical behavior of articular cartilage
7. Viscoelasticity, creep and stress relaxation response of the cartilage under compression. Permeability
8. Lubrication of articular cartilage, wear and hypothesis on cartilage degeneration
9. Mechanical behavior and biomechanical properties of ligaments
10. Clinical tests to assess for ligament tears, viscoelastic behavior and its clinical relevance
11. Mechanics of muscle contraction; summation and tetanic contraction, Types of muscle contraction
12. Biomechanics of bone fracture fixation, fracture stability and healing, fixation devices and methods