Course Syllabus
BMT 338

1. **Course number and name:** BMT 338 / Introduction to Biomedical Engineering Design
2. **Credits and contact hours:** (2 + 0) credit hours, (2 + 0) contact hours
3. **Instructor's name:** Dr. Wissal Mesfar
4. **Text book, title, author, and year:**
   a. **Books or notes**:
      - Mechanics of Materials, 6th Edition, James M. Gere, 2004
      - Mechanics of Biomaterials - Fundamental Principles for Implant Design, Lisa Pruitt Cambridge University Press, 2012.
      - Lecture notes Syllabus of Lab (available on LMS system)

   b. **Other supplemental materials:**
5. **Specific course information**
   a. **Brief description of the content of the course:**

   At the beginning, this course provides students with knowledge in mechanics of material including determination of the different stress and strain relationships to solve mechanical structure under various applied loading type such as axial loading, torsion loading and bending loading. The course provides as well methods to draw the shear force and bending moment diagrams. In the second part and based on the knowledge of the previous chapters, the course provides an application on the design of a hip implant to reduce the stress shielding in the femoral bone after a total hip replacement. Determination of stress of a composite structure made of metal and bone will be provided. The bone remodeling phenomenon will be considered to optimize the design of hip stem geometry by determining the best geometrical and material properties parameters to reduce the stress shielding.

   Prerequisites or co-requisites:
   Pre-requisites: BMT 232
   Co-requisites: None

   b. **Indicate whether this course is a required, elective, or selected elective (as per Table 5-1) course in the program:**
   Required

6. Specific goals for the course

a) Specific outcomes of instruction:

By the end of this course, the student should be able to demonstrate the ability:
- to use the mechanics of material theory to solve problems related to mechanical structures under various type of loading.
- to use the mechanics of material theory to design mechanical structures including mechanical biomedical devices, artificial human joints, and biomedical implants.

b) Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

	Course outcome	Abet (a-k)
1	Ability to select mechanics of material to solve problem and analyze mechanical structures under various type of loading.	b, f
2	Ability to use the mechanics of material theory to design mechanical structures including mechanical biomedical devices, artificial human joints, etc.	b, d

c) Brief list of topics to be covered

Topics
Introduction of the course, review of statics
Axial Loading (Tension and Compression): Stress-strain curves, superposition method, compatibility equations, truss structures resolution, thermal stress.
Torsion Loading: Relationship between torque loading and the induced stress, strain, and twisting angle, transmission of Power by Circular Shafts.
Shear force and bending moment diagrams: Internal forces in beams, relationships between loads, shear forces, and bending moments and drawing of the shear force and bending moments diagrams.
Bending Moment Loading: Centroid of plane and composite areas, moments of inertia, parallel-axis theorem, pure and nonuniform bending, longitudinal strains, normal stresses, design of beams for bending stresses, shear stresses of rectangular cross section, shear stresses in the webs of beams with flanges, built-up beams and shear flow.
Optimization of the design of the stem of hip prosthesis to reduce stress shielding in the femoral bone. Stress and strain in composite beam (made of idealized bone and biocompatible material), material and geometry optimization to reduce bone absorption.

	Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.)	Week Due	Proportion of Total Assessment
a.	At the end of each chapter, one assignment (two assignments for chap 2) should be done and submitted per due date (7 assignments in total).	One week after the end of the chapter	All the assignment accounts for 30%
b.	1 Mid term	Week 8-9	30%
c.	Final Exam	Please refer the Final exam schedule	40%