Table 1: HUT Engineering Biomechanics Course- Spring 2009			
Session	**2009 Date**	**Topic**	**Environment**
1	Mon	Course expectations – Professor, Homework, Syllabus, Grading, Objectives	On-site
2	2/9	Introduction - History	On-site
3	Wed	Introduction to Design - The Process	On-site
4	2/11	Kinetics - Forces (Linear Velocities, Accelerations)	On-site
5	Fri	Introduction to Design - The Report	On-site
6	2/13	Kinetics	On-site
7	Mon	Introduction to Design - The Presentation	On-site
8	2/16	Statics - Basics	On-site
9	Wed	Human Anatomy - Musculoskeletal System	On-site
10	2/18	Statics - Bioapplications	On-site
11	Fri	Human Anatomy - Simple and Articulating Joints	On-site
12	2/20	Mechanics of Materials – Stress and Strain	On-site
13	Mon	Getting acquainted with Elluminate – Stress and Strain	On-site
14	2/23	Mechanics of Materials – Material Properties	On-site
15	Wed	Introduction to Stress/Bending	Online
16	2/25	Advanced Stress/Bending - Neutral Axis, Parallel Axis Theorem	Online
17	Wed	Structure of Bone	Online
18	3/4	Mechanical Properties of Bone	Online
19	Wed	Fracture Mechanics and Breaks	Online
20	3/11	Fracture Mechanics and Healing	Online
21	Wed	Tendons /Ligaments – Structure and Properties	Online
22	3/18	Tendons / Ligaments - Mechanical and Viscoelastic Properties	Online
23	Wed	Articular Cartilage – Structure and Function	Online
24	3/25	Articular Cartilage - Mechanical Properties	Online
25	Wed	Introduction to Joints – Structure and Function	Online
26	4/1	Introduction to Joints – Types and Movement	Online
27	Wed	Implants – Devices and Materials	Online
28	4/8	Implants – Bone Plate Analysis and Design	Online
29	Wed	Knee Biomechanics – Structure and Function	Online
30	4/15	Knee Biomechanics – Movement and Forces	Online
31	Wed	Midterm Exam	Online
32	4/22	Midterm Exam	Online
33	Wed	Hip - Structural Components	Online
34	4/29	Hip - Biomechanical Properties	Online
35	Wed	Spine - Structural Components	Online
36	5/6	Spine - Biomechanical Properties	Online
37	Mon	Review Midterm Exam	On-site
38	5/11	Introduction to Muscle - Anatomy	On-site
39	Wed	Introduction to Muscle – Micro- and Macro-Structure	On-site
40	5/13	Introduction to Muscle - Mechanics	On-site
41	Fri	Built in Flexible Time	On-site
42	5/15	Built in Flexible Time	On-site
43	Mon	Design Presentations	On-site
44	5/18	Design Presentations	On-site
45	Wed	Design Presentations	On-site
46	5/20	Design Presentations	On-site
47	Fri	Final Exam	On-site
48	5/22	Final Exam	On-site

Engineering Biomechanics Design Project

Scenario: You are the principal design biomedical engineer for the Hanoi University of Technology College of Medical Hospital. As a result of recent governmental initiatives their is a new country-wide project to provide on-demand bone plates that are custom manufactured at on-site regional hospitals to repair long-bone fractures. There is great pressure to keep costs contained. You have observed that during some surgical procedures to repair/plate long-bone fractures, there is uncertainty and waste regarding the selection and use of the best bone plate. Your job is to work with the surgeon to identify in advance of, and during the surgical procedure, the best choice for the size of the plate based on patient anthropometric data. For this particular case, the patient is YOU!

Patient data: weight__________kg height____________cm
For this case the bone to be plated is the tibia. The length of the tibia is 25% of your height. There is a small amount curvature (bowing) in the tibia that results in a 1% of body height mid-bone displacement from the vertical (and thus creating a bending moment even when just standing). The outside diameter of the tibia at mid-length is 1.5% of body height.

Your job is to select the cross-sectional dimensions of a bone plate to stabilize the fracture. You know that a realistic approach to achieving this is to select/design a bone plate whose cross-sectional dimensions result in the situation where the neutral axis is located at the interface between the plate and the bone. As you do this, you notice that you are actually calculating I_p, and that quantity by itself does not uniquely determine both the thickness (t) and width (b) of the plate. You use your smarts to know that you do not want the plate to protrude through the skin (requiring a relatively small thickness) and that you want the BUCMH machinist to largely be able to use relatively standard stock metal, which comes in 0.25-cm widths and thicknesses (so you may slightly be rounding up/down your dimensions). So with this information you are able select a plate thickness and corresponding width.

Second, you plan to locate the plate on the tensile side of the fracture. Assume the installation of the plate itself results in a compressive force of one half body weight. What degree of bending (displacement at the transverse axis of the plate kind of related to the radius of curvature) is required to assure that the fracture site remains under compression when the bone is subjected to four times body weight (in case you accidentally stumble down the stairs while you are rehabilitating). Assume the plate length is ten times its width (while this is a reasonable value, it is not based on any engineering rationale). For this portion of the problem you will also need to know the Young's Modulus of the plating material (for the previous portion of the problem, you can get away with using an E_p/E_b ratio =10, I think; E_b=10x10^9 N/m^2 and E_p=100x10^9 N/m^2).

In providing your design, use an application software package with clearly identifies inputs, units, remarks, and other documentation that explains your approach from beginning to end. Most specifically your solution must clearly identify the dimensions you select for your plate, the degree of plate mid-point displacement (curvature). If you correctly approach the problem but encounter unrealistic assumptions or dimensions, adjust and justify them accordingly. Your full design report must provide full documentation so that the Chief Orthopedic Surgeon can present your results and report to the Minister of Health, whose education is in politics and not medicine or engineering. Good luck!