MAE 473 – BIOENGINEERING/BIOMECHANICS  3 CR  
Fall 2013  
MWF 2:00 – 2:50 Room 449 ESB  

Instructor:  
Dr. Sam Mukdadi  
Room G58 ESB  
Phone: 304-293-3110  
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Office hours: M W 4:00 – 5:00  

References:  

Suggested Journals:  
Annals of Biomedical Engineering  
Journal of Biomechanics  
Progress in Biophysics & Molecular Biology  
The Journal of Bone and Joint Surgery  
Biomaterials  
Journal of the American College of Cardiology  

Grading:  
Exam#1……………………………………….. 20%  
Exam#2……………………………………….. 20%  
Homework and Reading Assignments 30%  
Final Exam (Project)……………….. 30%  

Make-up exams will be strongly discouraged. If at all permitted, the make-up will be given at the instructor's convenience. A final letter grade will be assigned on the following basis: A (90 – 100), B (80 – 89), C (70 – 79), D (60 – 69), F (< 59).  

Overview:  
The objective of this course is to introduce the undergraduate student to the basic approach of mechanics and reinforces the practice of this approach via the formation and solution of a host of problems from cardiovascular, musculoskeletal, pulmonary and cell mechanic. Topics in biosolid mechanics include the analysis of extension, inflation, torsion, bending, and buckling problems that are important in both clinical and basic science settings. Topics in biofluid mechanics include fluid statics, Bernoulli’s equation Navier-Stokes solutions, non-Newtonian fluids, and control volume analysis of flows in cell systems, arteries and veins, and airways.  

Attendance:
Students are urged to attend all classes, but there is no direct penalty for failing to attend. Students are individually responsible for knowing all material presented and announcements made during a class that they did not attend. If a group of over ten students must be absent for some common reason, then that group should approach me, so that I can adjust the material presented on the day of absence. Since there is no requirement for students to attend every class, class will proceed despite bad weather, unless the University itself is closed.

Homework Assignments:
Written and reading homework assignments will be given to students in a weekly basis. The objective of these assignments is to improve understanding the material taught in the classroom.

Mid-term and Final Exams:
Mid-term and final exams will be conducted during the semester. The exams will be closed book and closed notes. All types of calculators will be allowed. If a student misses an exam, a legit excuse must be submitted to instructor within 48 hours. Then, make-up exam will be scheduled at a convenient time.

Academic Honesty:
I expect that homework, projects and examinations will be completed by the individual alone. Cheating and Plagiarism (see http://www.as.wvu.edu/psyc/Undergraduate/Handbook/StudentSuccess/plagiarism.htm) will not be tolerated. The instructor will pursue detected cases according to WVU policy. Under this policy, if the instructor and student cannot reach consensus on the sanction for the act of dishonesty, the case is referred to the Office of Student Judicial Affairs. (See http://www.studentlife.wvu.edu/judicial.html)
See http://www.arc.wvu.edu/rightsa.html#Anchor-1.-12494 for detailed information on the Judicial Affairs process.

Statement on Social Justice:
WVU is committed to social justice. The instructor of this course concurs with WVU’s commitment and expects to maintain a positive learning environment, based upon open communication, mutual respect and nondiscrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color, or national origin. Any suggestions are encouraged as to how to further such a positive and open environment and to anticipate needing any type of accommodation in order to participate in this class. Please advise us and make appropriate arrangements with Disability Services (293-6700).
TENTATIVE COURSE CONTENT

1. Introduction to Biomechanics
2. Biosolid Mechanics: Stress, Strains and Constitutive Relations
   A. Concept of stress
   B. Stress transformation
   C. Principal stresses and maximum shear
   D. Concept of strains
   E. Constitutive behavior
   F. Mechanical properties of bone
3. Equilibrium, Universal Solutions and Inflation
   A. General equilibrium equations
   B. Navier-space equilibrium equations
   C. Axially loaded rods
   D. Pressurization and extension of a think-walled tube
   E. Thick-walled cylinders
4. Extension and Torsion
   A. Deformation due to extension
   B. Shear stress due to torsion
   C. Principal stresses and strains in torsion
   D. Angle of twist due to torque
   E. Bone properties
   F. Papillary muscles
   G. Inflation, extension and twist
5. Nonlinear Biomechanics
   A. Kinematics
   B. Pseudo-elastic constitutive relations
   C. Design of biaxial tests on planar membranes
   D. Stability of elastomeric balloons
   E. Residual stress and arteries
   F. Vascular smooth muscle
6. Biofluid Mechanics: Stress, Motion and Constitutive Relations
   A. Stress and pressure
   B. Kinematics: the study of motion
   C. Constitutive behavior
   D. Blood characteristics
7. Fundamental Balance Relations
   A. Balance of mass
   B. Balance of linear momentum
   C. Navier-Stokes equations
   D. Euler equation
   E. Bernoulli equation
   F. Measurement of pressure and flow