

Advanced Impact Biomechanics Fall 2007

ME 5754, BMES 5164 at VT, and BMES 616 at WFU
Monday and Wednesday 2:30-3:45

Professors: Dr. Stefan Duma, Dr. Clay Gabler, Dr. Joel Stitzel
Office hours: Monday and Wednesday 1:30 – 2:30

Prerequisites:

ESM 2204 and ESM 2304, If you have not taken these, please see me after class.

Required Textbook:

Atlas of the Human Body by Takeo Takahashi, Harper Collins Publishers, New York, 1994. (about \$25.00)

Reference Textbooks:

Accident Analysis and Prevention: Melvin and Nahum

INTRODUCTION

This course serves as an introduction to the field of impact biomechanics. It is applicable to undergraduate and graduate students who are interested in acquiring an in-depth understanding of human tolerance to impact loading. Emphasis is placed on the interdisciplinary nature of impact biomechanics, which uses the combination of fundamental engineering principles and advanced medical technologies to develop injury prevention measures. Real world examples from automobile safety, military applications, and sport biomechanics are used to augment the lecture material.

COURSE OBJECTIVES

1. Familiarization with basic concepts in anatomy, biology, and engineering that form the basis for problems in impact biomechanics.
2. Ability to apply these basic concepts to more complex analysis
3. Understanding of the research tools available in impact biomechanics and how to access these tools.
4. Critical evaluation of the current state of research on key topics in impact biomechanics
5. Provide a framework for self-teaching and research

COURSE CONTENT

Currently, there is no single book that provides an interaction to the field of impact biomechanics. For this reasons, individual handouts will be prepared for each topic as needed and augmented by guest lectures. **(get a 2 or 3 inch D ring binder)**

Notes posted on Virginia Tech Blackboard, access through main page www.vt.edu and upper right pull down menu. The 'CH #' on the pre-class column denotes chapters that will be placed on the blackboard for you to download

Class Date	Topic	Pre-class Reading	Quiz/HW Due	Professor
Aug 20	Introduction and course overview, Motivation, fatality numbers; Anatomy I - Functional Anatomy			Dr. Duma
<u>Aug 22</u>	Anatomy II – Anatomy and Reference Frames; Wound Healing	Anatomy book	Quiz (class 1)	Dr. Duma
Aug 27	Injury Severity Scaling, AIS, HARM etc; Injury databases (NASS and CIREN)		Quiz (class 2)	Dr. Gabler
<u>Aug 29</u>	Data Scaling; mass scaling, geometric scaling, age scaling, etc AND General Stats: t-test, ANOVA, exp design, excel			Dr. Gabler
Sept 3	Applied Mechanics I: Stress/strain, elasticity, plasticity, coupon, 3pt versus 4 pt+SAE paper; STATIC forces and moments in body			Dr. Duma
<u>Sept 5</u>	Forces/Stresses; Injury Criteria Development, Statistical Applications		HW: 3 and 4 pt loads	Dr. Duma
Sept 10	Crash Severity Metrics (DV, BES, other)		HW: BW3 criteria	Dr. Gabler
<u>Sept 12</u>	Injury Reconstruction – part 1			Dr. Gabler
Sept 17	Injury Reconstruction – part 2			Dr. Gabler
<u>Sept 19</u>	<u>Exam 1</u>			Amanda proxy
Sept 24	Medical imaging modalities and methods for determining bone mineral density	CH 6		Dr. Stitzel
<u>Sept 26</u>	Data Acquisition: instrumentation, sampling rates, filtering, common mistakes	CH 2		Dr. Stitzel
Oct 1	Injury Reconstruction: 4 parts, from No 3 crash; belt usage marks, vehicle inspection, tissue transfer UV light; matching injuries	CH 8 + CH 9	HW: Das filtering etc	Dr. Stitzel
<u>Oct 3</u>	Uni-axial, versus bi-axial testing, calculating strain, pros/cons etc			Dr. Duma
Oct 8	Applied Mechanics II – DYNAMIC, spring/mass dashpot, inertial compensation etc, femur tests, thoracic loading examples			Dr. Duma
<u>Oct 10</u>	Pregnant Occupant Biomechanics: High speed impact to everyday accelerations		HW: mass scaling	Dr. Duma
Oct 15	Head/brain Accelerations: football, brain strain, automobile, ejection, pilot accelerations, compare to everyday	CH 5, papers		Dr. Duma
<u>Oct 17</u>	Spine: vertebral bodies and discs, QLV, tolerance; Cervical, thoracic, lumbar, ejections versus everyday	Book chapter		Dr. Duma
Oct 22	Safety Standards: FMVSS 100 and 200 series, IIHS, NCAP, other tests, car crashes, , Non automotive: NOCSAE, ANSI etc	Summarize 201-214+	H	Dr. Stitzel
<u>Oct 24</u>	Intro to CIREN & NASS databases			Dr. Stitzel
<u>Oct 29</u>	<u>Exam 2</u> Stapp attendees can take early			Amanda proxy
<u>Oct 31</u>	Using the Accident Databases FARS+NASS.			Dr. Gabler
Nov 5	Chest Injury Mechanisms		Reading due	Dr. Stitzel
<u>Nov 7</u>	Abdomen Injury Mechanisms		Reading due	Dr. Stitzel
Nov 12	Viscoelastic I and II			Dr. Duma
<u>Nov 14</u>	TBD			Dr. Duma
<u>11-25</u>	<u>Thanksgiving Break</u>			
Nov 26	Lumped Mass Modeling of Human Impact - 1			Dr. Gabler
<u>Nov 28</u>	Lumped Mass Modeling of Human Impact - 2			Dr. Gabler
Dec 3	Injury Metrics or Comparison of NASS/CIREN			Dr. Stitzel
Dec 5	Course Review			Dr. Duma
Dec 12	Final Exam (Comprehensive) 4:25 pm – 6:25 pm In Randolph 220		Final Exam	

COURSE ORGANIZATION and GRADING SYSTEM

Homework assignments and quizzes will be given periodically throughout the semester. The final grade will be determined by a combination of the course requirements:

Homework and Quizzes	30%
Includes pre and post	
Exam 1	20%
Exam 2	20%
Final Exam	25%
<u>Class Folder*</u>	<u>5%</u>
Total	100%

*Class Folder: Each student must bring their class folder to the final exam. At this time the Instructor will grade them. To receive full credit, they must be neat, organized with clearly marked tabs that denote each major topic.

Grades will be based most likely on the following scale; however, the instructor reserves the right to curve the grades up or down based on the overall class performance:

92 +	A
90 – 92	A-
88 – 90	B+
82 – 88	B
80 – 82	B-
78 – 80	C+
72 – 78	C
70 – 72	C-
68 – 70	D+
62 – 68	D
60 – 62	D-
0 – 60	F

Attendance at all classes is mandatory and no late assignments will be accepted.