



Ph.D. Qualifying Exam: Biomechanics

Department of Mechanical Engineering University of Utah

Exam Description:

The objective of this exam is on the topic of biomechanics. The reference textbooks and course material that serve as a basis for this exam are taken from ME EN 6535 Introduction to Biomechanics. The exam emphasizes applications to the human body including the following topics: human anatomy and anthropometry; applications of statics and dynamics to evaluate forces and their consequences; experimental techniques in biomechanics; stress and strain in tissues, with particular application to bone; material anisotropy; viscoelasticity; muscle mechanics; and soft tissue mechanics. Students should be able to:

- Perform whole body statics and dynamics analysis
- Perform whole body motion capture and force analysis using experimental techniques
- Develop an appreciation of how environmental conditions and microstructural features of biological tissues contribute to the mechanical response of the human body
- Quantify the viscoelastic responses of biological tissues
- Quantify biological soft tissue mechanics.

Recommended References:

- DA Winter. Biomechanics and Motor Control of Human Movement, 4th Ed. 2009. ISBN: 978-0-470-39181-8-0.
- YC Fung. Biomechanics: Mechanical Properties of Living Tissues. 2nd Ed. 1993. ISBN: 0-387-97947-6.

Exam Materials:

An equation sheet will be provided to students for their preparation before the exam. The same sheet will be provided with the exam. Students need to bring a department issued calculator. No other materials will be allowed during the exam.

Topics:

Exam topics include:

- Anthropometry
- Kinematics
- Kinetics
- Muscle and joint mechanics
- Gait analysis
- Signal processing
- Data acquisition
- Filtering
- Mechanics of biological materials and experimental design,
- Biological constituents and structure
- Generalized Hooke's law
- Bone mechanics
- Viscoelasticity
- Imaging techniques and analysis