ME 406 COURSE PROFILE

DEGREE PROGRAM: Mechanical Engineering

<table>
<tr><td>COURSE NUMBER: ME 406</td><td>COURSE TITLE: Biomechanics for Eng Students</td></tr>
<tr><td>REQUIRED COURSE OR ELECTIVE COURSE: Elective</td><td>TERMS OFFERED: Fall or Winter</td></tr>
<tr><td>TEXTBOOK / REQUIRED MATERIAL:</td><td>PRE / CO-REQUISITES: MECHENG 320 and MECHENG 382. II (3 credits)</td></tr>
<tr><td>COGNIZANT FACULTY: E. Meyhofer</td><td rowspan="2">COURSE TOPICS:

1. Introduction to biological principles: cells, self-replication, complex systems and evolution
2. Biomolecules: energetics, catabolism and biosynthesis, protein structure-function relationship of protein machines, catalysis; nucleic acids and information
3. Methods in Biology and Biological Research
4. Cytoskeleton: microtubules and actinfilaments
5. Biomolecular motors: force generation, step size analysis, single molecule mechanics
6. Mechanics of the cytoskeleton: force generation and active polymerization
7. Cell motility: mechanical models and molecular mechanisms
8. Mechanics of DNA and RNA
9. Skeletal muscle: structure, physiology, muscle mechanics, energetics and control, models
10. Cardiac and insect flight muscle, diversity and adaptations
11. Hearing: Mechanics and molecular mechanisms
12. Vision: optics, signal processing from the retina to the visual cortex
13. Respiration and gas exchange
14. Mechanics of circulation and blood rheology
15. Viscoelastic materials
16. Stiff and fibrous composites
17. Biological ceramics: from bones to egg shells
18. Biomimetics
19. Animal locomotion: swimming, flying, running and crawling, cost of locomotion, neuromuscular control
20. Scaling problems: from bones to metabolic rates and ecosystems</td></tr>
<tr><td>BULLETIN DESCRIPTION: Fundamental properties of biological systems, followed by a quantitative, mechanical analysis. Topics include mechanics of the cytoskeleton, biological motor molecules, cell motility, muscle, tissue and bio-fluid mechanics, blood rheology, bio-viscoelasticity, biological ceramics, animal mechanics and locomotion, biomimetics, and effects of scaling. Individual topics will be covered on a case by case study basis.</td></tr>
<tr><td colspan="2">COURSE STRUCTURE/SCHEDULE: Lecture: 2 days per week at 1.5 hours</td></tr>
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COURSE OBJECTIVES: for each course objective, links to the Program Outcomes are identified in brackets.	1. To teach the fundamental principles that characterize life and biosystems [1] 2. To teach key aspects of molecular mechanisms of cellular function [1] 3. To teach how biosystems transduce energy and information [1] 4. To teach biomechanical principles that govern how organs and the human body work [1] 5. To teach principle and unique properties of biological materials [1, 2, 6] 6. To study animal locomotion [1] 7. To introduce students to cutting-edge bioengineering research methods [1, 2, 4, 6, 7] 8. To apply quantitative (undergraduate) engineering knowledge to selected biological systems [1] 9. To introduce engineering students to research opportunities in the life sciences [7] 10. To relate fundamental bioengineering approaches to health-related biomedical research [4, 7] 11. To teach how biology impacts engineering and bio-nanotechnology [4, 7]
COURSE OUTCOMES: for each course outcome, links to the Course Objectives are identified in brackets.	1. Understand the basic principles that characterize living system [1, 2]. 2. Understand how molecular mechanisms control cellular function [1-3]. 3. Understand energy transduction in biosystems [3]. 4. Understand the quantitative, mechanistic aspects of organ and human body function [4-6]. 5. Understand how biological systems store and retrieve information [3]. 6. Understand the bioengineering foundations of animal locomotion [6]. 7. Understand the central role of ecosystems and energetics [3-6]. 8. Understand modern, quantitative, experimental research methods in bioengineering [7-10]. 9. Improve technical writing and communication skills [8-11]. 10. Understand the societal impact of bioengineering [10, 11]
ASSESSMENT TOOLS: for each assessment tool, links to the course outcomes are identified	1. Homework problems 2. Review and critique of selected primary literature 3. Written term papers 4. Written Exam

PREPARED BY: E. Meyhofer
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