



University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Mechanical Engineering
M.S./Ph.D. in Mechanical Engineering



Course Syllabus

1. General Information:
Alpha-numeric codification: INME 6065 Course Title: Principles of Biomedical Engineering Number of credits: 3 Contact Period: Three hours of lecture per week
2. Course Description:
English: Study of advanced general topics as applied to biomedical systems. Brief history of medicine, including human anatomy, physiology, and the rise of modern molecular biology. Description of the development of quantitative methods in biology, and the role of engineering in understanding complex biological systems. Description of relevant laws, professional ethics and regulatory environment.
Spanish: Estudio general de temas avanzados que se aplican a sistemas biomédicos. Breve historia de la medicina, incluyendo; anatomía, fisiología, y el auge de la biología molecular. Descripción del desarrollo de métodos cuantitativos en Biología, y el rol de la ingeniería en el entendimiento de sistemas biológicos complejos. Descripción de las leyes relevantes, la ética profesional y el entorno regulatorio.
3. Pre/Co-requisites and other requirements:
Pre-requisite: Authorization of the Director of the Department
4. Course Objectives:
<ul style="list-style-type: none">• Describing of the several sub-areas of Biomedical Engineering and the principles and applications that drive these sub-areas or tracks;• Recognizing the challenges and directions of the most dynamic core areas in Biomedical Engineering;• Applying electronics and measurement principles and techniques to the bioelectric phenomena;• Describing both living tissue and materials used for implantation;• Applying mechanics concepts to biological or medical problems;• Describing the basics of Biochemical Engineering (e.g. transport, reaction, and thermodynamics) as it applies to medicine and healthcare.
5. Instructional Strategies:
<input checked="" type="checkbox"/> conference <input checked="" type="checkbox"/> discussion <input checked="" type="checkbox"/> computation <input type="checkbox"/> laboratory
<input type="checkbox"/> seminar with formal presentation <input type="checkbox"/> seminar without formal presentation <input type="checkbox"/> workshop
<input type="checkbox"/> art workshop <input type="checkbox"/> practice <input type="checkbox"/> trip <input type="checkbox"/> thesis <input type="checkbox"/> special problems <input type="checkbox"/> tutoring
<input checked="" type="checkbox"/> research <input type="checkbox"/> other, please specify:

6. Minimum or Required Resources Available:

Classroom with data display. Computing facilities. Internet access.

7. Course time frame and thematic outline

General Topics	Reference
What is Bioengineering?	<i>Reading Assignment: Enderle 1.3</i>
Large biological molecules	<i>Reading Assignment: Campbell Biology Ch. 5</i>
The Cell	<i>Reading Assignment: Campbell Biology Ch. 6</i>
Anatomy & Physiology Basics – Circulatory, Nervous, Skeletal and Muscular	<i>Enderle, Hole's, OpenSTAX</i>
Introduction to Engineering	<i>Units and Basic Concepts – In class ppt</i>
Basic Materials Science	
Basic Mechanics of Materials	
Biomechanics – Anatomy and Physiology of Bone	<i>Chapter 7 Hole's Essentials</i>
Biomechanics – Biomechanics of Bone	<i>Nordin & Frankel Chapter 2 Biomechanics of Bone, Knudson Ch4</i>
Biomechanics – Anatomy and Physiology of Muscle	<i>Boron Ch. 9 & Hole's Essentials Ch8</i>
Biomechanics – Biomechanics of Muscle	<i>Knudson Ch4, Nordin & Frankel Ch6</i>
Biomechanics – Basic Fluid Mechanics	
Biomechanics – Fluid Mechanics in the Circulatory System	
EXAM 1	
Biomaterials – Polymers, Natural Materials and Metals	<i>Ratner et al. Biomaterials Science (2nd Ed.)</i>
Biomaterials – Cardiovascular devices	
Biomaterials – Orthopedics	
Biomaterials – Introduction to Biomaterial Host Response	
EXAM 2	
Bioinstrumentation & Bioelectric Phenomenon – Ohm's Law	
Bioinstrumentation & Bioelectric Phenomenon – First Order Systems, Inductors & Capacitors	<i>1st Order ODEs in Electrical Systems</i>
Bioinstrumentation & Bioelectric Phenomenon – The Cell membrane	<i>Boron, Hole's Campbell Biology</i>
Bioinstrumentation & Bioelectric Phenomenon – Neurons & Action Potentials	<i>Boron, Hole's Campbell Biology</i>
Grad Students Presentations and Discussions	
Total hours: (equivalent to contact period)	45

8. Grading System
 Quantifiable (S/NS)
 Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams		0-40
<input type="checkbox"/> Final Exam		
<input checked="" type="checkbox"/> Short Quizzes		0-20
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Final Research Project		0-20
<input checked="" type="checkbox"/> Assignments		0-20
<input checked="" type="checkbox"/> Other, specify: Assistance		0-10
TOTAL:		100%

10. Bibliography:

Textbook:

1. Enderle, J. Blanchard, S. and Bronzino, J. *Introduction to Biomedical Engineering*. Massachusetts: Academic Press. 2011. Print. [Available at the Circulation Collection (TJ1075 .M36 2011), UPRM General Library]

Other resources:

2. OpenStax. (2013). *Anatomy & physiology*, Download for free at <http://cnx.org/content/col11496/latest/>
3. Reece, J. B., Urry, L. A., Cain, M. L. 1., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. *Campbell biology* (10th Edition). Boston: Pearson. 2014. Print
4. D. Shier, J. Butler, and Lewis, R. *Hole's Essentials of Human Anatomy & Physiology*. McGraw-Hill. 2011. Print.
5. Boron, W. and Boulpaep, E. *Medical physiology [electronic resource]: a cellular and molecular approach*. Elsevier. 2012. Print.
<http://site.ebrary.com/lib/uprm/reader.action?docID=10567380>
6. Buddy Ratner, Allan Hoffman, Frederick Schoen, & Jack Lemons (Eds). *Biomaterials Science* (2nd Edition). Massachusetts: Academic Press. 2004. Print.
7. Wong, Joyce Y., Bronzino, Joseph D., and Donald R. Peterson. *Biomaterials Principles and Practices*. Florida: CRC Press. 2012. Print. <http://dx.doi.org/10.1201/9781420040036>. [Available via CRCnetBASE, UPRM General Library Databases]
8. Duane Knudson. *Fundamentals of Biomechanics* (2nd Edition). New York: Springer. 2007. Print.
9. Nordin, M. & Frankel, V.H. *Basic Biomechanics of the Musculoskeletal System* (3rd Edition). Baltimore: Lippincott, Williams & Wilkins. 2001. Print.
10. Joseph D. Bronzino and Donald R. Peterson. *Biomedical Engineering Fundamentals*. CRC Press. 2014. Print. Available via CRCnetBASE, UPRM General Library Databases
<http://www.crcnetbase.com/doi/book/10.1201/b15482>
11. Electronic resources available through the Library's website:
<http://www.uprm.edu/library/cre/listdbsp.php?l=1&st=0&topic=77>.

11. Law 51: The Comprehensive Educational Services Act for People with Disabilities:

States that after identifying with the instructor and the institution, the student with disabilities will receive reasonable accommodation in their courses and evaluations. For more information,

contact the Department of Counseling and Psychological services at the Office of the Dean of Students (Office DE 21) or call 787-265-3864 or 787-832-4040 x 3772, 2040 and 3864.

12. Academic Integrity

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Students General Bylaws (Board of Trustees Certification 13, 2009-2010) states that academic dishonesty includes, but is not limited to: fraudulent actions; obtaining grades or academic degrees by false or fraudulent simulations; copying the whole or part of the academic work of another person; plagiarizing totally or partially the work of another person; copying all or part of another person answers to the questions of an oral or written exam by taking or getting someone else to take the exam on his/her behalf; as well as enabling and facilitating another person to perform the aforementioned behavior. Any of these behaviors will be subject to disciplinary action in accordance with the disciplinary procedure laid down in the UPR Students General Bylaws. —

13. Certification 06-43 of the Academic Senate

"The academic guidelines for offering online courses," defines: Traditional face-to-face courses are those that have less than 25% of the course's regular contact hours via the Internet. Therefore, a three-credit course will be considered "face to face" if, of the 45 hours of regular contact, 11 or less are taught via the Internet. According to certification 06-43 of the Academic Senate, a course may include up to 25% of its total contact hours via the Internet. The objective of this is so that all professors have this alternative in the case of any unscheduled eventuality.

14. Sexual Harassment: Certification 130-2014-2015 states:

Sexual harassment in the workplace and in the study environment is an illegal and discriminatory act and is against the best interests of the University of Puerto Rico. All persons who understand they have been subject to acts of sexual harassment at the University of Puerto Rico may file a complaint and request that the institution investigate, where necessary, and assume the corresponding action by the university authorities. If the complainant is a student, he or she must refer his or her complaint to the Office of the Student Ombudsperson or that of the Dean of Students.

Revised: February, 2019