

**Syllabus**  
**Orthopaedic Regenerative Engineering and Mechanobiology**  
**BIEN 234**  
**Fall 2015**

**Course Time: Monday 1:10pm ~ 3pm and Wednesday 1:10pm to 3pm**

**Instructor**

Dr. Jin Nam

Email: [jnam@engr.ucr.edu](mailto:jnam@engr.ucr.edu)

Office: 331 MS&E Bldg.

Office Phone: 951 827 2064

**Prerequisites**

BIOL 005A&B, BIEN110, BIEN140A, or equivalents; graduate standing or consent of instructor

**Course Description**

Introduces advanced biomechanics and mechanobiology of skeletal tissues including bone and cartilage through an understanding of structure-function relationship in biological tissues. Focuses on bone and cartilage regenerative engineering approaches based on scaffolds, stem cells and mechanotransduction.

**Learning Objectives**

At the end of this course, students will be able to accomplish the following.

1. Understand the initiation and progression of skeletal diseases and syndromes
2. Understand structure-function relationship in skeletal tissues
3. Understand biomechanics and mechanobiology of skeletal tissues at the molecular level
4. Determine design criteria for bone and cartilage regeneration
5. Demonstrate current trends in orthopaedic tissue regeneration

**Methodology**

A variety of activities including lectures, discussion, up-to-date literature review, student presentations, proposal writing will be used to facilitate students' learning.

**Course Text**

**Textbook:** None required; Lecture notes will be provided

This course bases on multidisciplinary fields that include biomechanics, mechanobiology, stem cells and tissue engineering. No comprehensive textbook is currently available.

**Suggested Reference Books**

1. **Bone and Cartilage Engineering.** Author: Ulrich Meyer, Hans Peter Wiesmann, 278 pages, Springer, ISBN: 978-3642064685 (2010) (ebook available through university library).

2. **Mechanobiology Handbook.** Author: Jiro Nagatomi, 563 pages, CRC Press, ISBN: 9781420091212 (2011).

3. **Principles of Regenerative Medicine**, second edition. Author: Anthony Atala, Robert Lanza, James A. Thomson, Robert Nerem, 1202 pages, Academic Press, ISBN: 9780123814227 (2010) (ebook available through university library).

4. **Essentials of Stem Cell Biology**, second edition. Author: Robert Lanza, 680 pages, Academic Press, ISBN: 978-0123747297 (2009) (reserved).

### Evaluation and Grading

Evaluation of Student Performance

Midterm In-Class Exam	30%
Final In-Class Exam	40%
In class discussion	30%
Total	100%

In class discussion:

For a given research or review paper, you prepare 3 questions to be discussed (could be fundamental questions, peer-critiques, etc.).

### Grading Scale

A+ ≥ 95.00	95.00 > A ≥ 90.00	90.00 > A- ≥ 88.00
88.00 > B+ ≥ 82.00	82.00 > B ≥ 80.00	80.00 > B- ≥ 78.00
78.00 > C+ ≥ 75.00	75.00 > C ≥ 72.00	72.00 > C- ≥ 70.00
70.00 > D+ ≥ 65.00	65.00 > D ≥ 62.00	62.00 > D- ≥ 60.00
	60.00 > F	

### Course Policies

Make-up exams can only be requested prior to the exam date with valid proof of excuses  
Cheating on exams and/or plagiarism in projects will result in an F grade given for the course.

### Exam/Report Schedule

TBD

### EMERGENCIES:

Who to call:

- o In an Emergency: UC Police: (951) 827-5222 (from cell) or 911 (from campus phones)
- o Department Lab Safety Officer phone: 951-403-0932
- o Hazardous spills: EH&S: (951) 827-5528 or 2-5528 from campus phones
- o Utility problems: Physical Plant: (951) 827-4214 (days) or (951) 827-4677 (evenings)
- o If there is an emergency in the building such as a fire, pull one of the building fire alarm pulls.
- o If the building alarm sounds go immediately to the building's emergency assembly area (EAA) BUILDING ASSEMBLY AREA LOCATION: \_\_\_\_\_

If injured:

o If life-threatening, call 911 (from a campus phone) or (951) 827-5222 (from cell)  
If non-emergency treatment is needed:

o Undergraduate: go to the Campus Health Center (daytime) or your plan's urgent care or emergency room (evenings)

o Graduate students should contact Bioengineering Department 951-827-5025 for medical center information

## Course Outline

Weeks	Lectures		Objectives	Assignments Due
	Topics	Reading		
1	Cartilage structure and function	Ref. Book 1 Chapter 2	Discuss structure-function relationship of cartilage, cellular components of cartilage	None
2	Bone structure and function	Ref. Book 1 Chapter 2	Discuss structure-function relationship of bone, cellular components of bone	None
3	Overview of skeletal diseases and syndromes	Articles	Introduce skeletal disease pathology such as osteoarthritis and osteoporosis	None
4	Cartilage biomechanics and mechanobiology	Ref. Book 1 Chapter 2 & Ref. Book 2 Section II	Discuss cartilage biomechanics and cellular mechanobiology (cartilage homeostasis)	None
5	Bone biomechanics and mechanobiology	Ref. Book 1 Chapter 2 & Ref. Book 2 Section II	Discuss bone biomechanics and cellular mechanobiology (bone remodeling)	None
6	Orthopaedic biomaterials and scaffolds	Ref. Book 1 Chapters 6, 9 & Ref. Book 3 Part 3	Discuss natural and synthetic scaffolding biomaterials for orthopaedic applications	Midterm
7	Stem cell biology and therapy	Ref. Book 4 Parts 1, 2, 5 & Ref. Book 2 Chapter 19, 20, 21	Discuss basic stem cell biology, mechanobiology and its therapeutic applications in orthopaedics	None
8	Cartilage regeneration approaches	Ref. Book 1 Chapters 3, 8, 10 & Ref. Book 3 Chapter 42	Discuss various cartilage regeneration approaches	None
9	Bone regeneration approaches	Ref. Book 1 Chapters 3, 8, 10 & Ref. Book 3 Chapter 40	Discuss various bone regeneration approaches	None
10	Osteochondral reconstruction	Ref. Book 1 Chapter 3	Introduce current trends in osteochondral tissue engineering	Final exam