

# **BMD ENG 475 Cardiovascular Biology and Engineering**

## **Instructor**

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## **Lectures**

Mondays and Wednesdays  
9:30 - 10:50 am

## **Classroom**

Tech LG62

## **Course description**

Concepts, foundations, approaches, and technologies of cardiovascular protective and regenerative engineering, and cardiovascular development, performance, and pathogenesis.

## **Objectives**

This course enables students to: 1) understand the molecular mechanisms of cardiovascular development, organization, performance, and pathogenesis; 2) formulate and analyze engineering problems in the cardiovascular system; and 3) understand the fundamentals of and design basic models for cardiovascular protective and regenerative engineering.

## **Text**

Liu SQ. *Cardiovascular Protective and Regenerative Engineering*. World Science, 2016 (tentatively). Chapters available from the instructor.

## **Grading**

Homework: 30% (weekly)  
Quizzes: 10% (weekly)  
Midterm: 20%  
Final: 30%  
Group design project and presentation: 10% (3 – 4 students/group)

## **Lectures**

<b>Part I</b>	<b>Introduction</b>
3/30 M	<b>Principles of cardiovascular <u>protective</u> engineering</b> Concepts Biological foundation Rationale General approach Applications  <i>Research design project discussion</i>

<b>Part II:</b>	<b>Cardiovascular protective engineering</b>
4/1 W	<b>Principles of cardiovascular <u>regenerative</u> engineering</b> Concepts Biological foundation Rationale General approach Applications
4/6 M	<b>Regional protective mechanisms against injury and disorders</b> Protective factors Mechanisms of action
4/8 W	<b>Trans-system protective mechanisms against injury and disorders</b> Protective factors Protective cells Mechanisms of action
4/13 M	<b>Cytokines</b> Classifications and functions Mechanisms of action
4/16 W	<b>Growth factors</b> Classifications and functions Mechanisms of action
4/20 M	<b>Protective engineering approach and technologies I</b> Targeted protective factor delivery Genetic modulations <ul style="list-style-type: none"> <li>Gene transfection</li> <li>Gene editing</li> </ul>
4/22 W	<b>Protective engineering approach and technologies II</b> Epigenetic modulation <ul style="list-style-type: none"> <li>DNA methylation</li> <li>Histone modifications</li> </ul> RNA interference <ul style="list-style-type: none"> <li>Small interfering RNA</li> <li>microRNA</li> </ul>
4/27 M	<b>Protective engineering for heart attack</b> Pathogenesis of heart attack Natural protective responses Protective engineering
4/29 W	<b>Protective engineering for stroke</b> Pathogenesis of heart attack Natural protective responses

Protective engineering

**5/4 M**

**Midterm**

**Part II:**

**Cardiovascular regenerative engineering**

5/6 W

**Biological basis of regenerative engineering I**

Cardiovascular development

5/11 M

**Biological basis of regenerative engineering II**

Fundamentals of stem cell biology

5/13 W

**Biological basis of regenerative engineering III**

Myocardial regeneration

Vascular regeneration

**5/18 M**

**Regenerative engineering for heart attack**

Embryonic stem cell-based therapy

Cardiac resident stem cell-based therapy

Myocardial patching

5/20 W

**Regenerative engineering for stroke**

Embryonic stem cell-based therapy

Cardiac resident stem cell-based therapy

5/25 M

**Memorial Day**

5/27 W

**Engineering therapies for congenital heart disorders**

Heart valve defects

Atrial and ventricular septal defects

Great vessel transposition and tetralogy of Fallot

6/1 M

**Regenerative engineering for arteries**

Arterial aneurysm

Arterial engineering and reconstruction

6/3 W

**Group presentation**

**6/9 Tuesday**

**Final exam 12 – 2:00 pm in Tech LG62**