

Course Outline, Fall 2025

125:572 Biocontrol, Modeling, and Computation in Physiological Systems
Tu, Th 10:20 am – 11:40 am

This course will be offered as an online course.

Prof. George Shoane, Email: shoane@soe.rutgers.edu
Office Hour: To be determined.

Note 1: Each Module in on Canvas will contain Instructions to students on how to proceed in that week's activities.

Note 2: There will be Zoom recordings of the lectures for student review.

Chapter

Topics

Module 1

1 Introduction to Control System

- A. Examples: heat control system, human lens control system, carotid sinus loop
- B. General control systems models
- C. Power spectrum and autocorrelation

Reading Assignment 1: On Canvas

Homework Assignment 1: On Canvas

Module 2

2 Modeling and Computation

- A. Solutions to 1st and 2nd-order Differential Equations
- B. Cayley-Hamilton Theorem; Introduction to state variable methods

Reading Assignment 2: On Canvas

Homework Assignment 2: On Canvas

Module 3

2 Modeling and Computation (con't)

- C. Block diagrams for 1st and 2nd-Order Systems
- D. Introduction to state variable methods

Reading Assignment 3: On Canvas

Homework Assignment 3: On Canvas

Module 4

2 Modeling and Computation (con't)

- E. State-transition matrix, resolvent matrix
- F. Introduction to state variable methods

Reading Assignment 4: On Canvas

Homework Assignment 4: On Canvas

Module 5

3 Cardiovascular Mechanics

- A. Anatomy of the heart
- B. Pressure-volume relationship
- C. Pressure-flow relationship

Reading Assignment 5: On Canvas

Homework Assignment 5: On Canvas

Module 6

3 Cardiovascular Mechanics (con't)

- D. Starling resistor
- E. Arterial systems and flow autoregulation
- F. Integrative pressure-volume and pressure-flow relationships of the heart
- G. Examples of practical aspects of cardiovascular mechanics

Reading Assignment 6: On Canvas

Homework Assignment 6: On Canvas

Module 7

4 Introduction to Circulatory Dynamics

- A. Navier-Stokes Equations
- B. Lamina flow between parallel plates; in cylindrical tube
- C. Reynolds number; wave propagation in blood vessels
- D. Wave transmission and reflection

Reading Assignment 7: On Canvas

Homework Assignment 7: On Canvas

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Module 8

5 Pulmonary Mechanics

- A. Basic anatomy
- B. Compliance of the lung and chest wall

Reading Assignment 8: On Canvas

Homework Assignment 8: On Canvas

Module 9

5 Pulmonary Mechanics (con't)

- C. Pressure-volume relationships of pulmonary system
- D. Pressure-flow relationships of pulmonary airways
- E. Practical aspects of pulmonary mechanics

Reading Assignment 9: On Canvas

Homework Assignment 9: On Canvas

Module 10

6 Anatomy and Physiology of the Eye

- A. Orbit & adjacent structure of the eye
- B. Cornea and sclera, retina

Reading Assignment 10: On Canvas

Homework Assignment 10: On Canvas

Module 11

6 Anatomy & Physiology of the Eye (con't)

- C. Neurophysiology of saccade and pursuit

7 Accommodation System

- A. Optics, Badal optometer
- B. Mechanism of accommodation

Reading Assignment 11: On Canvas

Homework Assignment 11: On Canvas

Module 12

10 Stability Analysis

- A. s-plane and frequency response
- B. Root locus

Reading Assignment 12: On Canvas

Homework Assignment 12: On Canvas

Module 13

10. Stability Analysis (con't)

- C. Routh table
- D. Nyquist stability criterion
- E. Gain and phase margins

Reading Assignment 13: On Canvas

Homework Assignment 13: On Canvas

Grading:	Percent
Homework	12
Midterm	43
Final	<u>45</u>
	100

Textbook: Biocontrol, Modeling, and Computation in Physiological Systems, G. Shoane, University Readers (an Imprint of Cognella, Inc), 14th Edition, 2025.