

Professor: Dr Michael Khoo, DRB-176, Tel: 740-0838 Office Hrs: **Tues 11-12 & Thurs 1-2 pm**
 Email: khoo@bmsr.usc.edu
 Teaching Asst: Limei Cheng Email: limeiche@usc.edu Office Hrs & Loc: **Mon 11-12, Wed 1-2 DRB-145**
 Class Meetings: **Thurs. 2 - 4:50 pm** in **GFS-101** (20 mins. break at ~3:30 pm)

Course Goals: To highlight the basic analytical techniques employed in control theory, systems analysis and model identification, and to demonstrate how these quantitative principles can be applied to obtain an improved understanding of the dynamic processes involved in physiological regulation.

Learning Objectives: Upon successful completion of this course, the student should be able to:

- Develop simple mathematical models of physiological control systems
- Apply the basic analytical techniques in control theory to determine the dynamic characteristics of linear closed-loop systems
- Apply basic system identification methods to estimate the parameters of physiological models
- Analyze and simulate the dynamics of simple nonlinear oscillators, neuronal models and closed-loop nonlinear systems with delayed feedback
- Use MATLAB and SIMULINK software to analyze and simulate models of physiological systems

LECTURE SCHEDULE: (*Superscripts refer to chapters in textbook for assigned reading*) (**REVISED 3/17/06**)

Jan.	12	Introduction; negative feedback; open- vs. closed-loop control; Static analysis ^{1,3} (<i>HW#1 assigned</i>)
	19	Designing dynamic models - system analogs ²
	26	Time-domain analysis ⁴
Feb	2	Physiological simulation using SIMULINK - Ivanova (HW#1 due ; <i>HW#2 assigned</i>)
	9	Frequency-domain analysis ⁵
	16	Stability analysis ⁶
	23	Review/Discussion of Homework & Example Problems (HW#2 due)
Mar	2	Application of stability analysis to physiological phenomena; Issues in Digital Simulation
	9	Mid-Term Exam
	16	SPRING BREAK - no class
	23	Physiological system identification ⁷ - Part I (<i>HW#3 assigned</i>)
	30	Physiological System Identification ⁷ - Part II (Project Assigned)
Apr	6	Physiological and artificial control of the upper airway muscles (Tran); Project Data Collection
	13	Nonlinear analysis of physiological systems ⁹ (HW#3 due ; <i>HW#4 assigned</i>)
	20	Simulation of complex dynamics in physiological systems ¹⁰
	27	Optimization and Adaptive Control ⁸ ; Discussion of HW#3, HW#4 and Project (HW#4 due)
May	1 (Mon)	Project Report Due by 12 noon
	4	Final Exam (2-4 pm)

<u>GRADING SCHEME:</u>	Homework (Best 3 of 4 sets):	20%
	Mid-term Exam:	30%
	Final Exam:	30%
	Project:	20%

(Participation in BMES-ERC Education/Outreach Program:

1 session = +20 pts to HW with lowest score

2 or more sessions = +20 pts each to 2 HW sets with lowest scores)

TEXTBOOK:

Khoo: *Physiological Control Systems - Analysis, Simulation and Estimation*, Wiley/IEEE Press, 1999.

NOTE: (1) Homework solutions and the Project report should be submitted on time (by **2 pm on date due or as specified otherwise**). Late submissions will be penalized at the rate of **20% per day**. Homework **> 1 week** late and Project Report **>2 days** late will **not** be graded.

(2) You may discuss strategies for doing the homework and project with your friends. However, **outright plagiarism will not be tolerated. All Exams should be completed strictly on an individual basis.**