جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Control Theory - ME 221B

Division	Physical Science and Engineering Division
Course Number	ME 221B
Course Title	Control Theory
Academic Semester	Spring
Academic Year	2017/2018
Semester Start Date	01/28/2018
Semester End Date	05/24/2018
Class Schedule (Days & Time)	09:00 AM - 10:30 AM | Mon Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Meriem Taous Laleg	taousmeriem.laleg@kaust.edu.sa	+966128080371	4205, 1, Al-Khawarizmi (bldg. 1)	by appointment

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	The aim of this course is to introduce the student to the area of nonlinear control systems with a focus on systems' analysis and control design. Nonlinear phenomena including multiple equilibria, limit cycles and bifurcations, will be presented. Lyaponuv and input output stability will be discussed. Examples of control design will be studied such as feedback linearization and sliding mode control. Many examples will be provided and designed controllers will be illustrated by simulation using Matlab and through experimental implementation in the control lab.
Course Description from Program Guide	An introduction to analysis and design of feedback control systems, including classical control theory in the time and frequency domain. Modeling of physical, biological, and information systems using linear and nonlinear differential equations. Linear vs. nonlinear models, and local vs. global behavior, Input/output response, modeling and model reduction, Stability and performance of interconnected systems, including use of block diagrams, Bode plots, the Nyquist criterion, and Lyapunov functions. Robustness and uncertainty management in feedback systems through stochastic and deterministic methods. Basic principles of feedback and its use as a tool for altering the dynamics of systems and managing uncertainty methods. Introductory random processes, Kalman filtering, and norms of signals and systems.
Goals and Objectives	- Learn mathematical and numerical tools for the analysis of nonlinear system - Learn some control strategies for nonlinear systems
Required Knowledge	Control theory A, linear algebra, differential equations
Reference Texts	Suggested references: - H. K. Khalil. Nonlinear Systems, 3rd Edition. Prentice-Hall, 2002. - J.J.E. Slotine and W. Li, Applied Nonlinear Control. Prentice-Hall, 1991. - S. S. Sastry. Nonlinear Systems: Analysis, Stability, and Control. Springer-Verlag, 1999.

Method of evaluation	**30.00**% - Final exam **25.00**% - Midterm exam **20.00**% - Homework /Assignments **25.00**% - Course Project(s)
Nature of the assignments	Homework including MATLAB based computer exercises will be assigned frequently. No late homework will be accepted. Consultation with other students on the problems is permitted but each student must submit his own and personal solution. Two identical solutions will not be considered. Projects based on lab experiments will be also assigned.
Course Policies	Attendance is strongly recommended. Syllabus adjustments and all possible modifications in the schedule and deadlines will be given in the class. It is your responsibility to make up the material and keep informed of any announcements. Also, be sure to note the following policies: 1- Solutions for the exams and homework must be labeled, written clearly and the pages must be numbered. 2- All exams are closed book. You may not use the textbooks, the notes or any other outside material. 3- The final exam will cover the whole course material. 4- Make up exams will be only given to students who have unforeseeable events. However, the makeup is possible only if the student informs me within 48 hours. A written proof must be also provided before the make up.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 01/29/2018 Thu 02/01/2018	Introduction to nonlinear models and nonlinear phenomena
2	Mon 02/05/2018 Thu 02/08/2018	- Phase plan -Bifurcation -Limit Cycle
3	Mon 02/12/2018 Thu 02/15/2018	-Stability definitions -Equilibriums -Linearization
4	Mon 02/19/2018 Thu 02/22/2018	Lyapunov Stability
5	Mon 02/26/2018 Thu 03/01/2018	-Lasalle's principle -Lyapunov for Time varying systems -Converse Lyapunov theorem
6	Mon 03/05/2018 Thu 03/08/2018	Input to state stability
7	Mon 03/12/2018 Thu 03/15/2018	input-output stability
8	Mon 03/19/2018 Thu 03/22/2018	-Review -Midterm exam
9	Mon 03/26/2018 Thu 03/29/2018	Feedback linearization I
10	Mon 04/02/2018 Thu 04/05/2018	Spring Break
11	Mon 04/09/2018 Thu 04/12/2018	Feedback linearization II
12	Mon 04/16/2018 Thu 04/19/2018	Lyapunov design and backsteeping control
13	Mon 04/23/2018 Thu 04/26/2018	Sliding mode control
14	Mon 04/30/2018 Thu 05/03/2018	Introduction to optimal control I
15	Mon 05/07/2018 Thu 05/10/2018	Introduction to optimal control II
16	Mon 05/14/2018 Thu 05/17/2018	- Review - Projects' presentation
17	Mon 05/21/2018 Thu 05/24/2018	Final exam
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Note

The instructor reserves the right to make changes to this syllabus as necessary.