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

Course Syllabus: Control Theory - ME 221A

Division	Physical Science and Engineering Division
Course Number	ME 221A
Course Title	Control Theory
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	10:30 AM - 12:00 PM | Mon Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Meriem Taous Laleg	taousmeriem.laleg@kaust.edu.sa	+966128080371	4306, 1, Al-Khawarizmi (bldg. 1)	By appointment

Teaching Assistant(s)

Name	Email
TBC	TBC

Course Information

Comprehensive Course Description	This course presents fundamental topics for the analysis of linear dynamical systems, i.e., systems that evolve in time that admit an underlying linear structure. The material in this course serves as the foundation for continued study in more advanced courses in control design and system theory.
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	Introduce fundamental material on dynamical linear systems
Required Knowledge	Calculus & ordinary differential equations, exposure to linear algebra and complex variables
Reference Texts	Linear Systems Theory J.P. Hespanha
Method of evaluation	**30.00**% - Final exam **20.00**% - Quiz(zes) **30.00**% - Midterm exam **20.00**% - Homework /Assignments
Nature of the assignments	Analytical problems and Matlab based comptuer problems will be assigned frequently. General discussions are allowed but individual solutions must be provided

Course Policies	- 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. - Solutions for the exams and homework must be labeled, written clearly and the pages must be numbered. - All exams are closed book. You may not use the textbooks, the notes or any other outside material. - The final exam will cover the whole course material. - Make up exams will be only given to students who have unforeseeable events. A written proof must be also provided before the make up.
Additional Information	Please don’t hesitate to ask your questions in the class, by e-mail or during the office hours. Don’t hesitate also to report any concerns regarding the course, the scheduling or any inconvenience. If you do not understand something, please don’t hesitate to stop me. I recommend you to use e-mail to contact me. If I can not answer by e-mail I will arrange an appointment.

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 08/26/2019 Wed 08/28/2019	State space equations (Interconnections and Linearization)
2	Mon 09/02/2019 Wed 09/04/2019	Solutions of state space equations I: –Time domain _ Unforced & matrix exponential _ Modal decomposition _ Forced
3	Mon 09/09/2019 Wed 09/11/2019	Solutions of state space equations II: –Variations _ Time varying systems _ Discrete time systems
4	Mon 09/16/2019 Wed 09/18/2019	Solutions of state space equations III: –Frequency domain _ Laplace transform review _ Transfer functions
5	Mon 09/23/2019 Wed 09/25/2019	Stability of linear systems I - Internal _ Lyapunov analysis _ Lyapunov equation _ Lyapunov indirect method: Nonlinear and perturbed systems
6	Mon 09/30/2019 Wed 10/02/2019	Stability of linear systems II I/O stability: H2, H-infinity, L1
7	Mon 10/07/2019 Wed 10/09/2019	Stability of linear systems III -Robust stability: Small gain theorem
8	Mon 10/14/2019 Wed 10/16/2019	Stability of linear systems IV -LMI analysis: Stability, H2 norm, H-infinity norm
9	Mon 10/21/2019 Wed 10/23/2019	Review and Mid-term
10	Mon 10/28/2019 Wed 10/30/2019	Controllability and state feedback I
11	Mon 11/04/2019 Wed 11/06/2019	Controllability and state feedback II
12	Mon 11/11/2019 Wed 11/13/2019	Observability and output feedback
13	Mon 11/18/2019 Wed 11/20/2019	Advanced topics
14	Mon 11/25/2019 Wed 11/27/2019	advanced topics
15	Mon 12/02/2019 Wed 12/04/2019	Review
16	Mon 12/09/2019	Exam

Note

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