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

Course Syllabus: Mechatronics - ME 222A

Division	Physical Science and Engineering Division
Course Number	ME 222A
Course Title	Mechatronics
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	02:30 PM - 04:00 PM | Sun Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Mohammad Ibrahim Younis	Mohammad.Younis@KAUST.EDU.SA	+966128080597	3219, 4, Al-Jazri (bldg. 4)	Tuesday and Thursday: 4-5:30 PM

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	A first course in Mechatronics with a focus on the modeling and simulation of micro electromechanical systems MEMS. The course will emphasize lumped-parameter modeling techniques, nonlinear analyses principles, and continuous beam theories. Design principles, analytical techniques, and numerical tools will be emphasized. The course involves a course project, in which the student is supposed to apply the analytical and numerical tools to simulate and design a MEMS/ NEMS device.
Course Description from Program Guide	Principles, modeling, interfacing and signal conditioning of motion sensors and actuators; acquire and analyze data and interact with operators. Basic electronic devices, embedded microprocessor systems and control, power transfer components and mechanism design. hardware-in-the-loop simulation and rapid prototyping of real-time closed-loop computer control of electromechanical systems; modeling, analysis and identification of discrete-time or samplesdata dynamic systems; commonly used digital controller design methods; introduction to nonlinear effects and their compensation in mechatronic systems; robotic manipulation and sensing; obstacle avoidance and motion planning algorithms; mobile robots, use of vision in navigation systems. The lectures will be divided between a review of the appropriate analytical techniques and a survey of the current research literature. Course work will focus on an independent research project chosen by the student.
Goals and Objectives	-Learning new modeling and simulation of electromechanical systems. -Learning new numerical and analytical techniques to tackle and analyze nonlinear systems. -Have good knowlede of MEMS/NEMS, thier general features, design issues, and solutions.
Required Knowledge	-Good standing in numertical simulations. -Good standing in mathematical modeling.
Reference Texts	*MEMS Linear and Nonlinear Statics and Dynamics*, Younis, Mohammad I., Springer, New York, 2011.
Method of evaluation	**25.00**% - Exam 2 **50.00**% - Homework /Assignments **25.00**% - Exam 1

Nature of the assignments	Weekely Homeworks involving numerical and/or analytical problems.
Course Policies	**Grading policy:** Homework 50%, Two Exams: 50%. **Attendance:** Is encouraged all time. Students should come no latter than 5 minutes of the start of the class.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 08/25/2019	Introduction to Mechatronics
1	Wed 08/28/2019	Introduction to Mechatronics/MEMS
2	Sun 09/01/2019	Microcontrollers and Microprocessors
2	Wed 09/04/2019	Operational Amplifiers (Op Amp)
3	Sun 09/08/2019	Data Acquisition
3	Wed 09/11/2019	Signal Processing, FFT
4	Sun 09/15/2019	-Free Vibration of Single-Degree-of-Freedom Systems
4	Wed 09/18/2019	-Forced Harmonic Excitation of Single-Degree-of-Freedom Systems
5	Sun 09/22/2019	University holiday
5	Wed 09/25/2019	-Vibrating MEMS Gyroscopes -Base Excitations of SDOF Systems and Accelerometers Principles
6	Sun 09/29/2019	-Vibrations of Two-Degree-of-Freedom Systems -Numerical Integration -MEMS Band-Pass Filters
6	Wed 10/02/2019	-Electrothermal Actuation
7	Sun 10/06/2019	-Piezoelectric Actuation and Detection
7	Wed 10/09/2019	-Electromagnetic and Magnetic Actuation
8	Sun 10/13/2019	-Peizoresistive Detection
8	Wed 10/16/2019	-Electrostatic Actuation and Detection (simple parallel-plate, comb-drive, torsional mirrors)
9	Sun 10/20/2019	-Stiffness of Microstructures -Spring-Mass Models
9	Wed 10/23/2019	-Damping in MEMS (focus mainly on squeeze film damping and some gas fundamentals)
10	Sun 10/27/2019	Mid-semester break
10	Wed 10/30/2019	-Nondimensionalization
11	Sun 11/03/2019	-Fixed Points and Linearization
11	Wed 11/06/2019	-Bifurcations of Fixed Points
12	Sun 11/10/2019	-Phase Portraits
12	Wed 11/13/2019	-Step-Input Actuation of Capacitive RF Switches
13	Sun 11/17/2019	-Dynamics of Torsional Actuators and Micromirrors
13	Wed 11/20/2019	-Nonlinear Oscillations
14	Sun 11/24/2019	**Microbeams**
14	Wed 11/27/2019	static
15	Sun 12/01/2019	linear vibration
15	Wed 12/04/2019	reduced order modeling, beams under electrostatic forces.

16	Sun 12/08/2019	Exams

Note

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