Course Syllabus Form

Course code:	EENG 485	Course title:	Nonlinear Control Systems

College: Engineering

Department: Electrical & Electronics Engineering

Program: Electrical and Electronics (for both Programs)

Course credits: 3-1-3

Course NQF Level: 8

NQF Credits: 3

Prerequisite: EENG 381

Lectures Timing & Location: MW, 1:00-2:45, Room: 14-140

Course web page: https: //www.dr-e-mattar-uob.com/, ebmattar@uob.edu.bh

Course Instructor: Dr Ebrahim A. Mattar

Office Hours and Location: MTW: 11-1 pm (14-143)

Course coordinator: Dr Ebrahim Mattar

Academic year: 2019/2020

Semester:	First	Second	Summer

Textbook(s):

Textbook(s):
Hassan K Khalil, Nonlinear Systems, 3rd Edition Prentice - Hall International (UK), 2002.

References:
JJE Slotine & W.LI. Applied Nonlinear Control. Prentice Hall, Englewood Clifs, New Jersey 1991.

Other learning resources used (e.g. e-Learning, field visits, periodicals, software, etc.):

Course description (as per the published):

Nonlinear Control treats the analysis and synthesis of nonlinear control systems. The course consists of three main parts: an analysis part presenting the theoretical foundation; a design part introducing the most important control design methods; and a part dealing with other nonlinear control methods.

Course Intended Learning Outcomes (CILOs)

	Mapping to PILOs										
CILOs	1	2	3	4	5	6	7				
Introduction: nonlinear problems and phenomena	✓										
Linearisation, phase-plane analysis, equilibria, oscillations		✓									
Stability theory: Lyapunov methods.											
Stability theory: input-output methods.		✓									
Describing function analysis.			✓								
High-gain design methods: linearization by high gain and sliding modes					✓	✓					
Lyapunov design methods, and feedback linearization, SMC, Adaptive Control					✓		✓				

Course assessment:				
Assessment Type	Details/ Explanation of Assessment in relation to CILOs	Number	Weight	Date(s)
Assignments (3): Online	1,2,3		20%	Refer to course weekly breakdown below
Assignments (2): Take Home	1,2,3,4,5,6,7		10%	Refer to course weekly breakdown below
Examinations Midterm - (1)	3,4		20%	Refer to course weekly breakdown below
Laboratory/Practical (4) Labs	1,4,6		10%	Refer to course weekly breakdown below
Final Examination	1,2,3,4,5,6,7		40%	(June -2020)
Total			100%	

Description of Topics Covered	
Topic Title	Description

(e.g. chapter/experiment title)	
Introduction: nonlinear problems and phenomena	Learn a variety of nonlinear problems and phenomena.
Linearisation, phase-plane analysis, equilibria, oscillations	How to find the equilibria of nonlinear systems, and how to do the analysis of motion using the concept of phase planes.
Stability theory: Lyapunov methods.	Analysis of nonlinear phenomena in nonlinear systems using the Lyapunov theorems, hence, to use the computational methods to enhance the analysis.
Stability theory: input-output methods.	Why the use of the input-output methods, and how they affect the system closed loop stability design. Show few examples also and illustrate that via simulations and practical laboratories sessions.
Describing function analysis.	Give full description about the describing functions, and how this theorem can be used towards the analysis of nonlinear systems.
High-gain design methods: linearization by high gain and sliding modes	Comparisons between different closed loop design methods, with High-gain design methods: linearization by high gain and sliding modes.
Lyapunov design methods, and feedback linearization, SMC, Adaptive Control	Much advanced closed loop nonlinear control design techniques, Lyapunov design methods, and feedback linearization, SMC, Adaptive Control.

Weekly Schedule

Week	Date	Topics covered	CILOs	Teaching Method	Assessment
1		Review		Lectures	
2		Nonlinear Control treats the analysis. Introduction: nonlinear problems & phenomena	1	,,	Self-assessment
3		Linearisation, phase-plane analysis, equilibria, oscillations	1,3	,,	Self-assessment
4		Stability theory: Lyapunov methods.	1,3	Practical work	Self-assessment
5		Stability theory: input-output methods.	1,3	Practical work	Quiz 1
6		Describing function analysis.	1,3	Practical work	Mid-Term
7		High-gain design methods: linearization by high gain and sliding modes	1,2	Practical work	Mid-Term
8		Mid-semester break			
9		High-gain design methods: linearization by high gain and sliding modes	1,2	Practical work	Self-assessment
10		Lyapunov design methods, and feedback linearization, SMC, Adaptive Control	1,3,5,6	Practical work	Self-assessment
11		Lyapunov design methods, and feedback linearization, SMC, Adaptive Control	1,3,5,6	Practical work	Quiz 2
12		Lyapunov design methods, and feedback linearization, SMC, Adaptive Control	1,3,5,6	Practical work	Self-assessment
13		Applications of NC-1	1,3,5,6	Practical work	Test2
14		Applications of NC-2	1,3,5,6	Practical work	Self-assessment
15		Review	1,3,5,6	Practical work	Self-assessment

16		Review	2,6	Practical work	Self-assessment

Prepared by:	Dr Ebrahim Mattar
Date:	28/09/2020