University of Tehran
School of Electrical and Computer Engineering

Course:	**8101948 –Advanced Nonlinear Control**
Course type:	EE*: Com ☐, E ☐, P ☐, B ☐, Con ☐, D ☐ — CE*: SW ☐, HW ☐, IT ☐ — Credit: 1 Required: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Elective: ☐ ☐ ☐ ☐ ☒ ☐ ☐ ☐ ☐
Level:	Undergraduate ☐ Graduate ■
Co-requisite(s):	None.
Prerequisite(s):	None.
Prerequisite by topic:	Nonlinear Control Systems
Textbook(s):	[1] Nonlinear Systems, by: H. K. Khalil; Prentice Hall, 3rd edition, Prentice Hall, 2002. [2] Nonlinear Systems: Analysis, Stability and Control, by: S. Sastry, Springer, 1999. [3] Singular Perturbation Methods in Control: Analysis and Designs, by: P.V. Kokotovic, H. K. Khalil, and J. O'reilly, Academic Press, 1986. [4] Essays on Control: Perspectives in the Theory and its Applications, H.L. Trentelman, and J.C. Willes (Eds.), Birkhauser, 1993.
Coordinator:	Yazdanpanah, Professor, School of ECE
Goals:	To familiarize the audience with advanced techniques of analysis and synthesis of nonlinear control systems.
Outcome:	Upon successful completion of the course, students will be able to 1. Evaluate the possibility of occurring bifurcation phenomenon in nonlinear systems 2. Study the stability properties of nonlinear systems whose linear approximations possess some eigenvalues on imaginary axis 3. Analyse I/O stability, ISS, Passivity, and boundedness of solutions for nonlinear systems 4. Analyse slowly varying nonlinear systems 5. Analyse and incorporate design tools for Singularly perturbed nonlinear systems 6. Use some design tools, e.g., Lyapunov Redesign, Backstepping, and Nonlinear H∞ Control
Topics:	Analysis 1) Bifurcation 2) Centre Manifold Theorem 3) Input-Output Stability

	4) Boundedness and Ultimate Boundedness 5) Input-to-State Stability 6) Passivity and Dissipative 7) Stability of Perturbed Systems 8) Slowly Varying Systems 9) Analysis of Singularly Perturbed Systems Design 1) Nonlinear Observers 2) Passivity Based Control 3) Controller Design for Singularly Perturbed Systems 4) Lyapunov Redesign 5) Backstepping 6) Nonlinear H∞ Control 7) New (applied/theoretical) emerging topics will be covered in the final projects.
Computer usage:	MATLAB
Assignments:	4 to 6 homework assignments
Projects:	None.
Grading:	Assignments: 25 % Midterm exams: 40 % Final exam: 35 %
Further readings:	
Prepared by:	Yazdanpanah, Professor, School of ECE
Date:	23 August 2017

*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics		
Con	Control		
D	Digital System		