Advanced Control Systems (I)

Anouncement #1

School of Mechanical Engineering
Dynamics and Control
2017-2018

Prof. Ali Ghaffari

TA: Hamid Rahmanei

*Course Description:

1- Concepts, Definitions and Expressions: *Physical/Mathematical Systems, State Variables, Input/Output, Static/Dynamic, Linear/Nonlinear, Lumped/Distributed Parameter, Time Variant (LTI)/Invariant (LTV), Continuous/Digital, Open Loop/Closed Loop.*

2- Continuous-Time Dynamical Systems Modelling (Classical Methods): *State Model, Equilibrium State, State Space Representation, Transfer Function, Zero/Pole, Controllable/Observable/Jordan C*

anonical Forms, Block-Diagram/Signal-Flow-Graph.

3- Continuous-Time Dynamical Systems Response and Behavior: *Solution/State Transition Matrix, Response Modes, Matrix Diagonallization, Vector Space, Base Vector, Similarity Transformation, Eigen Values/Vectors, Zero Input/Zero State Response, Trajectory, Phase Plane Portrait, Isocline Method.*

4- Discrete-Time Dynamical Systems Modelling and Response: *Discrete Time System, Difference State Equations, **Z** Transform, Shifting Theorem, Initial/Final Value Theorem, Convolution Theorem, Sampler, Zero Order Hold.*

5- Probability Theory of Random Variables, Processes and Sequences.

6- Stability of Dynamical Systems: *Asymptotic/Uniform/Global/Exponential Stability, Positive/Negative Definite, Lyapunov Stability, Semi-Definite Functions, Lyapunov Function, Lyapunov Direct Method, Lyapunov Instability Theorem, Bounded-Input-Bounded-Output (BIBO) Stability, Routh Method, Jury Method,* Nyquist *Theorem in Discrete Time Systems,*

7- Advanced Stability Methods.

8- Controllability and Observability: *Controllability in LTI/LTV Systems, Observability in LTI/LTV Systems, Eigen-Vector Relation with Controllability and Observability, Singular Value Decomposition (SVD), Balanced Realization Theorem.*

9- Linear State Vector Feedback Control (SVFC) System Design: *State Vector Feedback Control Law, Eigen-value Assignments, Stabilization, Digital SVFC, Finite Time Settling Controller (FTSC), SVFC Gain.*

10- State Observers: *Open-Loop Observer, Luinberger Observer, Full-Order Observer, Reduced Order Observer, Observer Gain, Discrete Time Observer, Finite Time Settling Observer (FTSO).*

11- Optimal Linear Quadratic Control (LQR).

12- Principle of Robust Control.

13- Kalman Filter.

**References: (Some of them are ready for download in: *http://wp.kntu.ac.ir/ghaffari~adv1.htm*)

1- **Prof, A. Ghaffari, "*Advanced Control Systems*," KNTU Publications, 2016.**

2- P. R. Belanger, "*Control Engineering: a modern approach*," Saunders College Publications, 1995.

3- R. C. Dorf, R. H. Bishop, "*Modern Control Systems*," Prentice Hall, 2011.

4- R. S. Burns, "*Advanced Control Engineering,*" Butterworth-Heinemann, 2001.

5- K. Ogata, "*Discrete-Time Control Systems,*" Prentice Hall, 1995.

6- N. S. Nise, "*Control Systems Engineering,*" John Wiley & Sons Inc, 2004.

***Numerical Simulation and MATLAB Implementation:

1- *MATLAB Application for Modern Control. (Open access in Course Site: http://wp.kntu.ac.ir/ghaffari~adv1.htm)*

****Contact:

Instructor: Prof, Ali Ghaffari: ghaffari@kntu.ac.ir

Teaching Assistant: Hamid Rahmanei: hrahmanei@mail.kntu.ac.ir, hamid.rahmanei20@gmail.com.