CONTROL SYSTEM-II
EE-601
Credit: 4
Contact: 3L+1T

Module 1 [15]
State variable model of continuous dynamic systems:
Converting higher order linear differential equations into State Variable (SV) form. Obtaining SV model from Transfer Function. Obtaining characteristic equation and transfer functions from SV model. Obtaining SV equation directly for R-L-C and spring-mass-dashpot systems.

Concept and properties associated with state equations. Linear transformations on state variables. Canonical forms of SV equations. Companion forms. Solutions of state equations. State transition matrix, properties of state transition matrix.

Controllability and Observability. Linear state variable feedback controller, the pole allocation problems. Linear system design by state variable feedback.

Module 2 [10]
Analysis of discrete time (sampled data) systems using Z-transform:
Difference equation. Inverse Z transforms. Stability and damping in Z domain. Practical sampled data systems and computer control system. Practical and theoretical samplers. Sampling as Impulse modulation. Sampled spectra and aliasing. Anti-aliasing filters. Zero order hold. Approximation of discrete (Z-domain) controllers with ZOH by Tustin transform and other methods. State variable analysis of sampled data system. Digital compensator design using frequency response.

Module 3 [15]
Introduction to nonlinear systems:
Block diagram and state variable representation of nonlinear systems. Characteristics of common nonlinearities.

Phase plane analysis of linear and nonlinear second order systems. Methods of obtaining phase plane trajectories by graphical method, isoclines method. Qualitative analysis of simple control systems by phase plane methods.

Describing function analysis. Limit cycles in nonlinear systems. Prediction of limit cycles using describing function technique.

Stability concepts for nonlinear systems. BIBO Vs state stability. Definitions of Lyapunov functions. Lyapunov analysis of LTI systems, Asymptotic stability, Global asymptotic stability. The first and second methods of Lyapunov to analyze nonlinear systems.

Problems based on the topics to be solved in the tutorial classes
Text Books:
1. Control System Engineering, D. Roy Chowdhuri, PHI
2. Control system Engineering, I.J. Nagrath & M. Gopal, New Age International.
3. Digital Control & State Variable Methods, M. Gopal, 2nd Edition, TMH
4. Introduction to Control Systems, D.K. Anand & R.B. Zmood , 3rd Edition, (Butterworth-Heinemann) Asian Books.

Reference Books:
1. Control System Design, Goodwin, Pearson Education.
2. Nonlinear Control system, J.E. Gibson, Mc Graw Hill Book Co.
3. Control theory & Practice, M.N. Bandyopadhyaya, PHI
4. Digital Control system, B.C. Kuo, Oxford University Press.
5. Digital Control System, C.H. Houpis, Mc Graw Hill International.
6. Discrete Time control system, K. Ogata, Prentice Hall, 1995
7. Sampled Data Control system, E.I. Jury, John Wiley & Sons Inc.
8. System Dynamics and Control, Eronini Umez, Eronini, Thomson
9. Modern Control system, R.C. Dorf & R.H. Bishop, Pearson Education
10. Control Engineering, Ramakalyan, Vikas
11. Control System R\Engineering, A. Natarajan Reddy, Scitech
12. Control System Theory with Engineering Application, Lyshevski, Jaico