

EE 571
Final Objectives:

At the completion of EE571, you should be able to perform the following objectives:

Exam I Objectives

- Obtain state variable model from a circuit (mechanical or electrical)
- Obtain a state variable model from a system
- Find the state transition matrix (e^{At}) 3 different ways
- Solve the state variable model using time domain techniques
- Prove basic Laplace transform theorems
- Solve the state variable model using Laplace transform techniques
- Identify redundant state variables
- Obtain a functional block diagram of a system from a schematic (component) diagram
- Obtain a transfer function from
 - a) Block diagram reduction
 - b) A state variable model
 - c) A SFG using Mason's gain formula
 - d) From actual step response data
 - e) Directly from a circuit
- Analyze and design 2nd-order systems
- Determine 2nd-order parameters (e.g., t_s , t_p , and M_p) both analytically and experimentally
- Give definition of stable, marginally stable and unstable systems in terms of:
 - a) The zero-input response and the eigenvalues of A
 - b) The impulse response and the poles of H(s)
- Use integration, transient response, frequency response, and steady-state response techniques to determine internal system parameters
- Obtain a simulation SFG diagram and a state variable model for a given transfer function ways:
 - a) Phase variables
 - b) Canonical (decoupled) variables
- Find similarity transformations to place a given state variable model into phase variable and canonical (decoupled) form
- Determine regions of the complex-plane where eigenvalues must reside to meet transient specs
- Determine controllable, observable, and stable eigenvalues of a single-input single-output (SISO) system
- Design a state feedback regulator of the form $w = -Kx$ to place eigenvalues of a single-input system in phase variable form.
- Use the controllability matrix to determine the number of uncontrollable modes \cdot (eigenvalues) of a multi-input system
- Understand and design Controllers for multi-input, multi-output systems

Exam II Objectives

- Do all Exam I objectives!

- Use the observability matrix to determine the number of unobservable modes \cdot (eigenvalues) of a multi-input system
- Understand and design full-order and improved observers for single- and multi-output systems
- Understand the concepts of stabilizability and detectability
- Understand the separation principle
- Analyze and design 2nd-order systems
- Use the Routh table to determine the stability of a system
- Determine the type number of a system
- Perform steady-state error analysis for a variety of type numbers and inputs
- Understand and construct root loci of systems
- Compensation techniques based on root locus:
 - a) Use specs to determine pair of dominant closed-loop poles
 - b) Understand and perform lead compensation and calculate angle of deficiency
 - c) Understand and perform lag compensation
 - d) Understand and perform pole-zero cancellation
 - e) Understand and perform proportional-plus-derivative compensation (PD)
 - f) Understand and perform proportional-plus-integral compensation (PI)
 - g) Understand and perform proportional-plus-integral-derivative compensation (PID)
- Realize compensators using op-amps
- Frequency domain techniques:
 - a) Understand and construct asymptotic Bode plots
 - b) Obtain models from experimental data
 - c) Model and understand the effect of quadratic terms on bode plots
 - d) Model and understand the effect of non-minimum phase terms on bode plots
- Understand and construct polar plots
- Use the mapping theorem to determine stability (Nyquist stability)
- Understand and evaluate gain and phase margins
- Design simple attenuators to meet gain and phase margin specs

Post-Exam II Objectives:

- Measure gain and phase margins from actual data
- Use the design equations for a lead compensator using frequency response criterion
- Derive design equations for lag compensators in the frequency domain
- Design lead and lag compensators to meet frequency response criterion
- Find the bandwidth of a closed-loop system and determine the effect of additive noise in the input

