



Course Code ECE-364	Course Title Control Systems	ECTS Credits 6
Department Engineering	Semester Spring	Prerequisites ECE-330
Type of Course Required	Field Engineering	Language of Instruction English
Level of Course 1 st Cycle	Year of Study 3 rd	Lecturer(s) Dr George Gregoriou
Mode of Delivery Face-to-face	Work Placement N/A	Co-requisites None

Objectives of the Course:

The main objectives of the course are to:

- Provide solid knowledge foundation on feedback control principles.
- Introduce fundamental analysis tools using state variable and frequency response methods for determining control system performance.
- Develop skills for the design of feedback control systems.

Learning Outcomes:

After completion of the course students are expected to:

- Use ordinary differential equations to model simple electrical and mechanical systems.
- Represent linear time-invariant systems in both time and frequency domains using state variable models, transfer functions, block diagrams and signal-flow graphs.
- Compute the system response characteristics; determine transient response, steady-state response and steady-state errors.
- Perform absolute and relative system stability analysis.
- Use the root-locus technique and Nyquist's criterion to analyze systems.
- Have the necessary skills for designing PID, phase-lead, and phase-lag controllers using root-locus and Bode plots.
- Design a feedback control system to meet specified objectives.
- Use design and simulation software such as MATLAB.

Course Contents:

- Mathematical modeling of control systems, Laplace transform, transfer function, block diagrams, signal-flow graphs, state variable models, state differential equation, time response, state transition matrix
- Feedback control system characteristics such as sensitivity, disturbance signals, and steady-state error
- Feedback control systems performance: test input signals, second-order system

performance, damping ratio, transient response measures (rise time, peak time, percent overshoot, settling time), steady-state error, and performance indices

- The concept of absolute stability, Routh-Hurwitz criterion, relative stability, stability of state variable systems, stability in the frequency domain, Nyquist stability criterion, gain and phase margins
- The root locus procedure as a tool for analyzing and designing feedback control systems, parameter design, sensitivity of the roots to parameter variations, PID controllers
- Frequency response using polar plots and Bode diagrams, log magnitude and phase diagrams. Concepts of design and compensation of feedback control systems, phase lead and phase lag design using Bode diagram and root locus

Learning Activities and Teaching Methods:

Lectures, in-class examples and exercises.

Assessment Methods:

Homework, exams, final exam.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
R. C. Dorf R. H. Bishop	Modern Control Systems	Prentice Hall	2008	0132270285

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
G. F. Franklin J. D. Powell A. Emami-Naeini	Feedback Control of Dynamic Systems	Prentice Hall	2006	0131499300