

[COURSE PROFILE

Course Number : EE 352	Course Title : System Dynamics and Control
Required / Elective : Elective	Pre-requisite : MATH 220 or MATH 203
<p>Catalog Description: Analysis of linear control systems by differential equations and transfer function methods. Transient response of first and second order systems. Stability of closed loop systems. Routh-Hurwitz criterion, root-locus diagrams. System analysis in frequency domain. Bode and polar plots. Nyquist stability criterion. Introduction to the design of linear control systems, compensation techniques.</p> <p>[This course is equivalent to ME 336 Modeling and Control of Dynamic Systems (3+1+0) 3]</p>	<p>Textbook / Required Material :</p> <p>K. Ogata, <i>Modern Control Engineering</i>, Fourth Edition, Prentice-Hall, 2002</p>
Course Structure / Schedule : (3+1+0) 3 / 6 ECTS	
<p>Extended Description : Introduction of concepts and techniques of classical closed loop control and the types of basic control actions. Familiarization of students with mathematical modelling of dynamic systems and with analytical methods like Laplace transformation and transfer function representation. Basic goal of the course is to enable students to analyze linear control systems, design appropriate controllers and synthesize stable feedback control systems.</p>	
<p>Design content : Routh-Hurwitz table used as a design tool for the choice of system parameters to assure stability. Lead or Lag compensator design using the root-locus plot. Use of Bode plots for frequency domain design of stable systems.</p>	<p>Computer usage:</p> <p>Use of MATLAB and / or SIMULINK for analysis and design problems</p>
<p>Course Outcomes: [relevant program outcomes in brackets]:</p> <ol style="list-style-type: none"> a) Recognize the main components of a control system and the terminology regarding input, output, error signal, control action, controlled variable etc. Describe the differences between open loop and closed loop control. Explain the advantages of feedback control and the socio-economical importance of various automatic control applications.[3, 10] b) Demonstrate the convenience of Laplace transformation and transfer function for modeling complex interconnected linear systems.[2, 6] c) Derive mathematical models for primarily electrical, mechanical or electro-mechanical systems [2, 6] d) Calculate the time domain unit impulse, unit step and unit ramp response of first and second order systems. Determine the time characteristics of the response and their dependence on the damping ratio and the natural frequency of the system.[2, 5, 6, 7] e) Appraise the effects of PID control and the role of integral control in determining the 	

steady state error behavior of the system.[2, 5, 6, 7]

- f) Construct the root-locus of a system using the basic construction rules. Use MATLAB to generate root-locus plots.[2, 6, 11]
- g) Investigate the stability of a linear control system and the nature of the time behavior of its unit step response using the root-locus plot.[5, 11]
- h) Design lead or lag compensators using the root-locus techniques in order to achieve a desired system behavior.[6, 7]
- i) Determine the frequency response of a dynamic system. Construct the asymptotic Bode plots. Appraise the stability of the system from those plots. [2, 6]
- j) Design appropriate controllers using the Bode plots. Use MATLAB [6, 7, 11]
- k) Apply Ziegler-Nichols methods to tune controllers. [6]

Level of Contribution of Course to Program Outcomes:

Strong: 2,5,6

Average: 7,11

Some: 3,10

Recommended reading:

B. C. Kuo, *Automatic Control Systems*, 7 th Edition, Prentice-Hall, 2001

R. C. Dorf, R. Bishop, *Modern Control Systems*, 11th Edition, Prentice-Hall, 2008

Teaching Methods:

Pre-readings, lectures and problem sessions, individual exercises and computer based homework, MATLAB programming project

Assessment Methods : [Related to course outcomes]

Midterm Exams [b,c,d,e,f,g,h,i]

Homeworks

MATLAB Project [f,j]

Final Exam [d,e, f,g,h,i,j,k]

Student survey (suggested)

Student Workload:

Preparatory reading 55 hrs

Lectures,problem sessions 50 hrs

Homeworks 24 hrs

Projects 12 hrs

Midterm Exams 6 hrs

Final Exam 3 hrs

TOTAL 150 hrs = 25 x 6 ECTS

Prepared by : Prof. Yorgo Istefanopulos

Revision Date : 8 February 2010