

EE451/ME453 – Control Systems -- 4 Credits
 South Dakota School of Mines & Technology
 Spring Semester 2010
 EP 255 2:00pm-2:50pm MWF

Instructor	Dr. Charles Tolle, Office: EP 323, Phone: 394-6133, Email: charles.tolle@sdsmt.edu
Prerequisites	EE 311: Systems or ME 352: Introduction to Dynamical Systems
Office Hours	MWF 10:00am-11:00am, W 3:00pm-4:00pm, or by appointment.
Holidays	Martin Luther King Day – January 18 Spring Break – March 6-14 President's Day – February 15 Easter Break April 2-5
Textbook	<i>Control Systems Engineering, 5th Edition</i> , by Norman S. Nise, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ, 07030, 2008.
Chapter Order	8,9,10,11 – Intros to follow-on classes 12,13
Supplementary Books (some newer additions exist)	<i>Control Tutorials for MATLAB and Simulink: A Web-Based Approach</i> , by W.C. Messner and D.M. Tilbury, Addison Wesley Publishing Company, 1999. <i>Feedback Control of Dynamic Systems</i> , G.F. Franklin, J.D. Powell, and A.Emani-Naeini, Addison Wesley Publishing Company, 1988. <i>Automatic Control Systems: Fifth Edition</i> , B.C. Kuo, Prentice-Hall, Inc., Englewood Cliffs, NJ 07632, 1987.
Modeling Reading (some newer additions exist)	<i>Principles of Mathematical Modeling</i> , C.L. Dym, Elsevier Academic Press, 2004. <i>Dynamics of Physical Systems</i> , R.H. Cannon, Jr., McGraw-Hill Publishing Company, 1967. <i>Dynamical Systems with Applications Using MATLAB</i> , S. Lynch, Birkhauser, Boston, MA, 2004. <i>Flight Stability and Automatic Control</i> , R.C. Nelson, McGraw-Hill Publishing Company, 1989. <i>The Nature of Mathematical Modeling</i> , N. Gershenfeld, Cambridge Univ. Press, 1999.
Math Reading (some newer additions exist)	<i>Signals and Systems</i> , A.V. Oppenheim, A.S. Willsky, Prentice-Hall, Inc., Englewood Cliffs, NJ 07632, 1983. <i>Signals and Systems: Continuous and Discrete</i> , R.E. Ziemer, W.H. Tranter, D.R. Fannin, Prentice-Hall, Inc., Englewood Cliffs, NJ 07632, 1983.
Matlab Tutorials	http://scv.bu.edu/documentation/tutorials/MATLAB/ http://www.maths.dundee.ac.uk/~ftp/na-reports/MatLabNotes.pdf http://www.math.utah.edu/lab/ms/matlab/matlab.html
Grading Policy	<p>5 % Attendance, Participation, and Professionalism</p> <p>10 % Homework Assignments and Quizzes (~ 6 assignments – Quizzes as needed)</p> <p>10 % Labs (~5 in general the labs will be open throughout the course)</p> <p>20 % for each of the 3 Midterm Exams (on or about Feb. 26 and March 26th during class and May 7, 8-9:50am)</p> <p>15 % Final Project (Approved by Mar. 5, Design Specs Due Mar. 24, Report Due by April 23)</p> <p style="text-align: center;">The instructor reserves the right to modify this grading break down if warranted.</p> <p>Grades will be assigned according to natural grade groupings. However it is anticipated that the following scale will be used to assign final grades.</p> <p>100 – 90 A 89 – 80 B 79 – 70 C 69 – 60 D below 59 F</p> <p>The instructor reserves the right to modify this scale if warranted.</p>
Objectives	<p>The objectives of this course are to obtain knowledge in:</p> <ul style="list-style-type: none"> ▪ analysis of feedback control systems and specifications e.g. Root-locus techniques (including Routh-Hurwitz criterion), frequency response techniques (including Nyquist criterion), introduction to state-space design, introduction to digital design etc. ▪ design of systems to satisfy the given specifications e.g. Internal model principle, PI, PD, PID, lead, lag, lead-lag controllers, etc. ▪ modern computational software tools for analysis and design of feedback systems e.g. MATLAB (possible alternative software programs: Octave, Maple, or Sage). ▪ beginning design in State Space Control ▪ beginning design in Digital Control

<p>General Policies</p>	<p>Students are encouraged to work together on assigned homework problems. However, all homework, projects, and tests must <u>not</u> be plagiarized (from any source – even your classmates). Plagiarism is on the rise and it is not acceptable in any form! If caught plagiarizing, you will receive an F for the course and referred to the Department Head and Vice-President for Academic Affairs for further action. In short, you are expected to accomplish your own work! When using other's works cite them! Make-up tests will <u>not</u> be given unless a prior arrangement is made with the instructor. Students have two weeks following the return of any graded material to appeal the score.</p> <p><i>Note that according to "Policy Governing Academic Integrity" in the SDSM&T Undergraduate Catalog, the instructor of record for this course has discretion of how acts of academic dishonesty are penalized, subject to the appeal process, and that "Penalties may range from requiring the student to repeat the work in question to failure in the course" (72-73).</i></p> <p>Work will be due on at the start of class on the due date unless otherwise stated. Late work will receive up to ½ credit within one week of due date, i.e. up to the start of class one week later. After that time, late homework will <u>not</u> be accepted without the permission of the instructor.</p>
<p>Freedom in learning</p>	<p><i>Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the dean of the college which offers the class to initiate a review of the evaluation.</i></p>
<p>Electronic Devices Policy.</p>	<p><i>Please turn off your cell phone before class starts. No text messaging in class. No headphones. If you wish to use a laptop in this class for purposes of note taking, is acceptable. No other use of any other electronic/computer media is allowed during class time.</i></p>
<p>ADA Statement</p>	<p><i>Students with special needs or requiring special accommodations should contact the instructor, (Dr. <u>Charles R. Tolle</u>, at 394-6133 or by email at <u>charles.tolle@sdsmt.edu</u>) and/or the campus ADA coordinator, Jolie McCoy, at 394-1924 at the earliest opportunity.</i></p>
<p>COURSE OUTCOMES: Upon completion of this course, students should demonstrate the ability to:</p>	<ol style="list-style-type: none"> 1. Use block diagrams and signal flow diagrams to represent systems. 2. Analyze the performance of a system in the time and frequency domains. 3. Sketch and interpret stability and performance using root locus. 4. The ability to formulate design specifications for control systems. 5. Use root locus to design PD and lead controllers to improve the transient performance of a system. 6. Use root locus to design PI and lag controllers to improve the steady state error of a system. 7. Use root locus to design PID and lead/lag controllers to improve both the transient and steady state error of a system. 8. Use Matlab® as an analytical and design tool. 9. Use frequency domain techniques to design cascade compensation (lead, lag, lead/lag) to improve the transient and/or steady state error of a system. 10. Provide an introduction to State Space design: e.g controllability, observability, etc. 11. Provide an introduction to Digital Control System design: e.g z-transform, z-plane stability, z-plane design, etc.
<p>RELATION OF COURSE TO PROGRAM OUTCOMES: These course outcomes fulfill the following program outcome:</p>	<ol style="list-style-type: none"> (a) An ability to apply knowledge of mathematics, science, and engineering. (b) An ability to design and conduct experiments, as well as to analyze and interpret data. (c) An ability to design a system, component, or process to meet desired needs. (d) An ability to function on multi-disciplinary teams. (e) An ability to identify, formulate, and solve engineering problems. (f) An understanding of professional and ethical responsibility. (g) An ability to communicate effectively. (h) The broad education necessary to understand the impact of engineering solutions in a global and societal context. (i) A recognition of the need for, and an ability to engage in life-long learning. (j) A knowledge of contemporary issues. (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program outcomes listed above (on a scale of 0 to 4 where 4 indicates a strong emphasis)

		Course Outcomes										
		1	2	3	4	5	6	7	8	9	10	11
ABET Outcomes	(a)	1	3	4	4	4	4	4	4	4	2	2
	(b)	2	3	2	4	3	3	3	4	3	1	1
	(c)	1	2	4	4	3	3	3	4	3	1	1
	(d)		1	2	3				1			
	(e)	2	4	4	4	3	3	3	4	3	1	1
	(f)			1	3	1	1	1	1			
	(g)	1	1	1	3	1	1	1	3	1		
	(h)				1							
	(i)				1						1	1
	(j)				1				1		1	1
	(k)	1	3	3	1	4	4	4	4	4	1	1

PREPARED BY:

Charles Tolle, Date: Jan. 23, 2009.

REVISED BY:

Charles Tolle, Date: Jan. 15, 2010.