UBC Math 403, Autumn 2012

MWF 13:00-13:50, room MATH 204

http://www.math.ubc.ca/~loew/m403/

Topic Outline

Topic	Hours (Approx)
Differential Equations, Invariance, Stability • Linear constant-coefficient equations • Linear variable-coefficient ODE's • Nonlinear ODE's • Controlled ODE's • Linearization • Examples	**9**
Linear Control Systems • Controllability • Eigenvalue assignment by state feedback • Control constraints; Attainable Sets • Geometry of R^n • Boundary Trajectories • Time-Optimal Control • Examples: Rocket Car, Harmonic Oscillator • Unconstrained problems with quadratic objectives	**10**
Linear-Quadratic Optimal Control • Open-loop versus feedback formulations • Geometric Approach • Dynamic Programming Approach • Response-shaping by coefficient selection • Robust stability of LQ designs (but no H-infinity material)	**5**
Nonlinear Optimal Control • Free-terminal-point problems • Pontryagin Maximum Principle • Problems linear in the control; singular arcs • Turnpike solutions	**6**

Recent Advances One topic of current research interest selected by the instructor in consultation with the class, e.g., • Lyapunov's Direct Method, Flow-invariant sets, LaSalle's Theorem • Infinite-Horizon problems • Receding-Horizon Control • Hamilton-Jacobi Theory • H-infinity • Linear Matrix Inequalities in control system design	**4**
Total lecture-hours (excluding test)	**35**

Details--Autumn 2012

Required Text:

- None. Lecture notes will be provided.

Class Test:

19 Oct (Fri), 13:00-13:50 (50 minutes).

Other Important Dates:

- 05 Sep (Wed): Lecture 1—the first of the term.
- 18 Sep (Tue): Deadline to withdraw without having “W” appear on record.
- 12 Oct (Fri): Deadline to withdraw.
- 19 Oct (Fri): Midterm in class.
- 30 Nov (Fri): Last class of the term.
- 05–19 Dec inclusive: Formal examination period, includes Saturdays.

Grading Formula:

You can earn up to 40% from Homework due each Friday; 10% from the midterm test; and 50% from the Final Examination. The exam will last 2.5 hours, and be held at some time during UBC's formal examination period. The homework will be challenging and essential. Grades may be scaled due to the challenging nature of the course material.

Policies:

- There is no supplemental examination in this course.
- Late homework assignments receive a grade of 0.
- Missing a midterm normally results in a mark of 0. Exceptions may be granted in two cases: prior consent of the instructor or a medical emergency. In the latter case, the instructor must be notified within 48

hours of the missed test, and presented with a doctor's note immediately upon the student's return to UBC.

Dr. Philip D. Loewen

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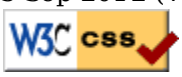
Official Calendar Entry

MATH 403 (3) **Stabilization and Optimal Control of Dynamical Systems.** Dynamical systems; stability by Liapunov's direct method; controllability and eigenvalue assignment for autonomous linear systems; linear-quadratic regulator, time optimal control, Pontryagin maximum principle, dynamic programming; applications in engineering, economics and resource management. Prerequisite: 1 of MATH 320, MATH 301. A grade of at least 68% in either course is required. MATH 402 is recommended. [3-0-0]

Last update: 05 Sep 2012 (Wed), 08:30:51.



(Click a graphic to recheck.)