Math53: Ordinary Differential Equations
Winter 2004

Midterm II Information

Wednesday, 2/25, 2:15-3:05p.m.

Last Names A-M: 380Y	*Last Names N-Z:* 380W

General Information

This will be a closed-book, closed-notes exam. No calculators will be allowed. Midterm II will cover Chapters 5 and 7-9 of the textbook. Make sure you can do all problem set exercises from these chapters and perhaps some other related problems from the textbook. Please look in detail over these chapters, the lecture summaries handed out in class, and the solutions to the last two problem sets. Even if you know how to do every problem on the problem sets, you might find that the solutions describe a different way of doing some problems, which is quicker in some cases.

Pre-Midterm II Office and Tutoring Hours

Over the next few days, I will have office hours Sunday 4-6, Monday 10-12, Tuesday 4-6, and Wednesday 10-12, in 383B. Most of these office hours are for this week only. As always, the course assistant, Isidora Milin, will have office hours Monday 12-1 and Wednesday 12-2 in 380S. The SUMO tutoring is on Monday 6-10 in 381T.

Background Material

You should be familiar with the most important facts from calculus and from the first third of this course.

Types of Problems to Expect

(1) *Definition and Properties of Laplace Transform:* write down the definition of LT and use it to compute LT of functions; use tables of LTs, as in *Unit 3 Summary*, to compute LT and inverse LT of functions. Examples: 5.1:1-29, 5.2:1-17,30-33,43, 5.3:1-36, 5.5:1-25.

(2) *Laplace Transform and ODEs:* use LT to solve IVPs involving high-order linear ODEs with constant coefficients: Examples: 5.4:1-36 and ODEs of high order.

(3) *Laplace Transform, Convolution, and Delta Function:* write the definition of convolution and use it to compute the convolution of two given functions; use convolution to find inverse LT of a product of two functions; compute the unit impulse function for an ODE and use it to solve an inhomogeneous IVP. Examples: 5.6:2-7, 5.7:4-24,26-31.

(4) *Linear Algebra:* find the nullspace of a matrix and/or a basis for the nullspace; compute the determinant; find the inverse of a matrix; find eigenvalues, eigenvectors, and generalized eigenvectors; find the exponential of a matrix; find the product of the exponential of a matrix and of a vector. Examples: 7.4:7-22; 7.5:1-40; 7.6:7-10,13-15,22-45,50-54; 9.1:1-12; 9.5:1-16,25-28.

(5) *Direction Fields, Component Plots, and Phase-Plane Portraits:* given a planar autonomous system of first-order ODEs, sketch the corresponding direction field; given several component plots, and phase-plane portraits match each component plot with its phase-plane portrait. Examples: 8.2:13-21.

(6) *Solutions of Systems of ODEs, Higher-Order Equations:* given several functions and several ODEs or IVPs, match each function with the ODE, or IVP, it solves; rewrite a high-order equation as a linear system. Examples: 8.1:7-16.

(7) *Qualitative Descriptions:* determine whether the origin is a stable or unstable equilibrium; whether it is a nodal/spiral sink/source, etc. Examples: 9.6:1-14 and (8) below.

(8) *Systems of Linear ODEs with Constant Coefficients:* find the general solution to planar and higher-order systems, homogeneous and inhomogeneous; solve initial value problems; sketch phase-plane portraits for planar homogeneous systems. Examples: 9.2:1-12, 23-64 + phase-plane plots; 9.4:7-11,21-26; 9.8:1-24.

Remarks: (a) The primary focus of the midterm will be on (8) above, for planar systems, and on (2). The other things are closely related.
(b) You do not have to memorize the exact expression for the real form of the general solution in the complex-eigenvalues case. However, you should have a good idea of what it looks like and what the corresponding phase-plane portrait looks like. For the final exam, you should either find a way of remembering the exact expression or know how to obtain it.