Math 135B: General Course Outline

Catalog Description

135B. Ordinary Differential Equations. Lecture, three hours; discussion, one hour. Prerequisites: Either 135A OR one upper division course in differential equations or mathematical methods of the physical sciences such as Physics 131, Mechanical and Aerospace Eng. 192A, EE 102, ChemEng 109.

Laplace transform method; existence and uniqueness results; series solutions at regular singular points; Sturm-Liouville problems, orthogonal series, eigenfunction expansions; two-dimensional autonomous systems, phase-plane analysis, stability and asymptotic behavior of solutions; selected applications.

Textbook

G. Simmons, *Differential Equations with Applications and Historical Notes, 2nd Edition*, McGraw Hill

Reviews & Exams

The following schedule, with textbook sections and topics, is based on 24 lectures. The remaining five classroom meetings (only four in Winter Quarter) are for midterm exam(s) and reviews.

Schedule of Lectures

Lecture	Section	Topics
1-5	Chapt. 6, Sections 33, 34, 35, 37, 38, assign 36 ("Extension to arbitrary intervals" as reading)	Fourier series and orthogonal functions.
6-10	Chapt. 7, Sections 40, 41, 42, 43, Appendix 7A	Partial Differential Equations and Boundary Value Problems
11-14	65 (introduction), 66 (Euler's equation), 67 (Isoperimetric problems) and possibly appendix 12B.	Calculus of Variations
15-21	Chapt. 8, Sections 44-47 and Appendices 8ABC.	Some Special Functions of Mathematical Physics
22-24	Chapt. 13	Existence and uniqueness.

Comments

One midterm, usually after Lecture 14, plus 2-3 days of leeway, review, or additional topics.

There is a little overlap with Math 146, but 146 has far more calculus of variations. The amount of duplication does not seem undesirable. There is also some overlap with the Fourier series in Math 131B and that is all to the good. My current students have seen Fourier series previously, but are much in need of concrete nontrivial manipulative practice.

The syllabus is flexible. The major topics can be reordered. Instructors who use computer software in the course may modify the syllabus in order to adapt it to computer lab assignments.

The method of partial fractions (Section 21.3) is covered in the calculus sequence. It should be reviewed carefully by the TA in the first recitation section. Power series solutions of ODE's and Fourier series are also covered in the calculus sequence, in Math 33B. Students find this material difficult, and the topics should be covered carefully in lecture.

The introduction to phase-plane analysis and specifically the classification and description of the various cases in Chapter 19 should be based on the method of eigenvalues and eigenvectors rather than on an analysis of affine changes of variable. Students have seen eigenvalues and eigenvectors in the context of ODE's in Math 33A and again in Math 135A.

It is not possible to cover all topics listed in the syllabus carefully in lecture. Subsections that are omitted might still be covered in the assigned exercises. Subsections that can be easily omitted are the Heaviside superposition principle (22.3b), the tautochrone (22.3c), and test functions and the derivatives of the Dirac delta-function (22.1b). Proofs are not emphasized in the course. The proof of the theorem on pointwise convergence of Fourier series can be omitted, as can at least a portion of the proof of existence and uniqueness of solutions of ODE's.

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