

18.03: Differential Equations

Spring, 2012: Syllabus

I. First-order differential equations

- 0 T 7 Feb *Recitation*: Natural growth models; separable equations: EP 1.1, 1.4; Notes D.
- 1 W 8 Feb Solutions and direction fields: EP 1.2, 1.3; Notes G.1; SN 1.
- 2 F 10 Feb Autonomous equations; the phase line, stability: EP 1.7, 7.1.
- 3 M 13 Feb Numerical methods: EP 6.1, 6.2; Notes G.3.
[Guest lecturer: David Jerison]
- 4 W 15 Feb Linear equations; input-output models: EP 1.5; IR.1–3; SN 2.
- 5 F 17 Feb Solution of linear equations; variation of parameters: SN 3; EP 1.5.
PS1 due: on Lectures 0–3
- 6 T 21 Feb Complex numbers, roots of unity: SN 5; Notes C.1, C.4.
- 7 W 22 Feb Complex exponentials: Notes C.2–3; SN 6.
- 8 F 24 Feb Sinusoidal signals: SN 4; Notes IR.6.
PS2 due: 4–7

II. Higher-order linear equations

- 9 M 27 Feb Introduction to second order equations; springs and coils: EP 2.1 through p 105; SN 8.
- 10 W 29 Feb **Hour Exam I**
- 11 F 2 Mar Homogeneous equations: EP 2.2, 2.3 through p 130; SN 9.
- 12 M 5 Mar Complex roots, damping conditions: EP 2.3, 2.4.
- 13 W 7 Mar Driven systems: input-output models; superposition: EP 2.6, SN 10.
- 14 F 9 Mar Operators; Sinusoidal Response Method; superposition; undetermined coefficients: Notes O.2; SN 11; EP 25.
PS3 due: 8–12
- 15 M 12 Mar Resonance; variation of parameters; time invariance: Notes O.4, SN 12.
- 16 W 14 Mar RLC circuits; complex gain and frequency response: SN 8, 16; EP 2.6, 2.7.
- 17 F 16 Mar Review.
PS4 due: 13–16
- 18 M 19 Mar Applications in engineering: an interview with Prof. Steve Leeb.
- 19 W 21 Mar **Hour Exam II**

III. Transforms

- 20 F 23 Mar Fourier series: EP 8.1.
21 M 2 Apr Operations on Fourier series: EP 8.2, 8.3.
22 W 4 Apr Periodic solutions; resonance: EP 8.3, 8.4.
23 F 6 Apr Step function and delta function: SN 21.
PS5 due: 17–21
24 M 9 Apr Step response, impulse response: SN 22, 23; Notes IR.
25 W 11 Apr Convolution: Notes GC; SN 24.
26 F 13 Apr Laplace transform: basic properties: EP 4.1.
PS6 due: 22–24
27 W 18 Apr Laplace transform and ODEs: Weight and transfer:
SN 25, SN 26; Notes H; EP 4.2, 4.3.
28 F 20 Apr Laplace transform: higher derivatives, resonance: EP 4.4.
PS7 due: 25–27
29 M 23 Apr The pole diagram: SN 27, 28.
30 W 25 Apr **Hour Exam III**

IV. First order systems

- 31 F 27 Apr Matrices: Linear algebra: Notes LS.1; EP 5.3 through p 353.
32 M 30 Apr Eigenvalues, eigenvectors: Notes LS.2.2; EP 5.4 through p 367.
33 W 2 May Linear systems and matrices: EP 5.1–5.4; SN 30, Notes LS.1.
34 F 4 May Complex or repeated eigenvalues: Notes LS.3; EP 5.4.
PS8 due: 28–32
35 M 7 May Qualitative behavior of linear systems; phase plane:
Notes GS.1–5; SN 31.
36 W 9 May Normal modes and the matrix exponential: EP 5.7; Notes LS.6.
37 F 11 May Nonlinear autonomous systems: EP 7.2, 7.3.
PS9 due: 33–36
38 M 14 May Linearization near equilibria; the nonlinear pendulum:
EP 7.4, 7.5; Notes GS.6.
39 W 16 May Limitations of the linear: limit cycles and chaos: Notes GS.7.

Three hour comprehensive final exam
9:00 - 12:00 Tuesday, May 22, Johnson Track

References:

EP: C. Henry Edwards and David E. Penney, *Elementary Differential Equations with Boundary Value Problems*, Prentice-Hall, Sixth Edition.

SN: 18.03 Supplementary Notes, <http://math.mit.edu/classes/18.03/supplementary.html>.

Notes: 18.03 Notes and Exercises, <http://math.mit.edu/supnotes/supnotes03>.