

Readings

Listed in the table below are reading assignments for each lecture session.

[EP] refers to the course textbook: Edwards, C., and D. Penney. *Elementary Differential Equations with Boundary Value Problems*. 6th ed. Upper Saddle River, NJ: Prentice Hall, 2003. ISBN: 9780136006138

[SN] refers to the “[18.03 Supplementary Notes](#)” written by Prof. Miller.

[Notes] refers to the “[18.03 Notes and Exercises](#)” written by Prof. Mattuck.

Also listed are links to specially written Java™ applets, or [Mathlets](#), that were used in the lecture session.

I. First-order differential equations

R1	Natural growth, separable equations	[EP]: 1.1 and 1.4
		[EP]: 1.2 and 1.3
		[Notes]: G.1 (PDF)
L1	Direction fields, existence and uniqueness of solutions	[SN]: 1 (PDF)
		Isoclines Mathlet
		[EP]: 6.1 and 6.2
L2	Numerical methods	[Notes]: G.2 (PDF)
		Euler's method Mathlet
		[EP]: 1.5
L3	Linear equations, models	[SN]: 2 (PDF)
		[EP]: 1.5
L4	Solution of linear equations, integrating factors	[SN]: 3 (PDF)
		[SN]: 5 (PDF)
		[SN]: 6 (PDF)
L5	Complex numbers, roots of unity	[Notes]: C.1-3 (PDF)
		[SN]: 4 (PDF)
		[Notes]: C.4 (PDF) and IR.6 (PDF)
L6	Complex exponentials; sinusoidal functions	Complex roots Mathlet
		Complex exponential Mathlet
		[SN]: 4 (PDF)
L7	Linear system response to exponential and sinusoidal input; gain, phase lag	[Notes]: IR.6 (PDF)
		Trigonometric identity Mathlet
		[EP]: 1.7 and 7.1
L8	Autonomous equations; the phase line, stability	[SN]: Appendix A (PDF)
		Phase lines Mathlet
L9	Linear vs. nonlinear	[SN]: Appendix C (PDF)

II. Second-order linear equations

L11	Modes and the characteristic polynomial	[EP]: 2.1, 2.2, and 2.3 up to “Polynomial Operators” [SN]: 9 (PDF)
L12	Good vibrations, damping conditions	[EP]: 2.3 and 2.4 Damped vibrations Mathlet
L13	Exponential response formula, spring drive	[EP]: 2.6, pp. 157-159 [SN]: 7 (PDF) (for beats) [Notes]: O.1 (PDF) Harmonic frequency response: Variable input frequency Mathlet
L14	Complex gain, dashpot drive	[EP]: 2.6, pp. 165-167 [SN]: 10 (PDF) [Notes]: O.1, 2, 4 (PDF) Amplitude and phase: Second order II Mathlet
L15	Operators, undetermined coefficients, resonance	[EP]: 2.5, pp. 144-153 and EP: 2.7 [SN]: 8 (PDF) [SN]: 11 (PDF) [SN]: 14 (PDF) Amplitude and phase: Second order II Mathlet
L16	Frequency response	Amplitude and phase: First order Mathlet Amplitude and phase: Second order III Mathlet
L17	LTI systems, superposition, RLC circuits.	[SN]: Appendix B (PDF) Series RLC circuit Mathlet
L18	Engineering applications	[SN]: 12 (PDF) [SN]: 13 (PDF) [Notes]: O.3 (PDF)

III. Fourier series

L20	Fourier series	[EP]: 8.1 [SN]: 16 (PDF) Fourier coefficients Mathlet
L21	Operations on fourier series	[EP]: 8.2 and 8.3 Fourier coefficients: Complex with sound Mathlet
L22	Periodic solutions; resonance	[EP]: 8.3 and 8.4
L23	Step function and delta function	[SN]: 17 (PDF)
L24	Step response, impulse response	[SN]: 18 (PDF) [Notes]: IR (PDF)
L25	Convolution	[SN]: 18 (PDF) Convolution: Accumulation Mathlet Convolution: Flip and drag Mathlet
L26	Laplace transform: basic properties	[EP]: 4.1

L27	Application to ODEs	[EP]: 4.2 and 4.3 [SN]: 20 (PDF) [Notes]: H
L28	Second order equations; completing the squares	[EP]: 4.5 and 4.6 [SN]: 20 (PDF)
L29	The pole diagram	[EP]: 4.4 [SN]: 22 (PDF) [SN]: 23 (PDF) 18.03 Difference Equations and Z-Transforms (PDF)(Courtesy of Jeremy Orloff.) Amplitude response: Pole diagram Mathlet Poles and vibrations Mathlet
L30	The Transfer function and frequency response	
IV. First order systems		
L32	Linear systems and matrices	[EP]: 5.1-5.3 [SN]: 25 (PDF) [Notes]: LS.1 (PDF)
L33	Eigenvalues, eigenvectors	[EP]: 5.4 [Notes]: LS.2 (PDF) Linear phase portrait: Matrix entry Mathlet Matrix vector Mathlet
L34	Complex or repeated eigenvalues	[EP]: 5.4 [Notes]: LS.3 (PDF) Linear phase portrait: Matrix entry Mathlet
L35	Qualitative behavior of linear systems; phase plane	[SN]: 26 (PDF) Linear phase portrait: Matrix entry Mathlet Linear phase portrait: Cursor entry Mathlet
L36	Normal modes and the matrix exponential	[EP]: 5.7 [Notes]: LS.6 (PDF)
L37	Nonlinear systems	[EP]: 7.2 and 7.3 [Notes]: LS.6 (PDF)
L38	Linearization near equilibria; the nonlinear pendulum	[EP]: 7.4 and 7.5 [Notes]: GS (PDF) [SN]: Appendix B (PDF) [SN]: Appendix C (PDF)
L39	Limitations of the linear: limit cycles and chaos	Vector fields Mathlet



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