Syllabus ECE 493/Math 487

Jont B. Allen
ECE Department, University of Illinois at Urbana-Champaign
November 15, 2018

Rubric

Linear Algebra, Advanced Calculus, Boundary value problems, Sturm-Liouville Theory, Complex Variables

ECE-493 is divided into 4 basic sections (I-IV), divided into 40 topics, delivered as 24=4*6 lectures. There will be two mid-term exams and one final. There are (in theory) 14 homework assignments, with a 15 that does not count toward your final grade (HW0 is used for evaluation in the first week). Each exam (I, II and Final) will count as 30% of your final grade, while the Assignments (HW1-14) and class participation, count for 10%.

I Linear Algebra . . . [Ch. 8, 10, 11, 9, 12]

Lect.	#.Topic	[Chapter.Section]
1	1.Basic definitions	[8.1: p. 391]
	2.Elementary operations	[8.2: p. 392-395]
2	3.Solutions to $Ax = b$	[App. B, p. 1267-1270]
	4.Matrix inverse	[8.3: p. 396-411]
3	5.Matrix Algebra; Eigenvalues & vectors	[10.1,2: p. 465-480, 11: p. 541-582]
	6.Transformations (change of basis)	[10.2: p.]
4	7.Vector spaces $\mathbb{R}^n$	[9: p. 412-456]
5	8a.Optimal approximation (Least squares)	[9.10: p. 457-460
	8b.Legendre Functions (out of place?)	4.4: p 212-217]

II Advanced Calculus [Ch. 13, 15, 16]

Lect.	#.Topic	[Chapter.Section]
6	9.Partial differentiation ($\frac{\partial}{\partial x}$)	[13: p. 613-682]
	10.Line surface and volume integrals	[15: p. 714-756]
7	11.Gradient (∇), Divergence ($\nabla\cdot$), Curl ($\nabla\times$), Laplacian (∇^2)	[16: p. 757-843]
8	12.Implicit Functions and Jacobian (Change of Vars)	[13.6, p. 642-655]]
9	13.Potentials and conservative fields	[16.2 p. 758-760]
10	14.Theorems: Green, Stokes, Divergence	[16.3-10, p. 761-843]

Exam I

III Boundary value (BV) problems [Ch. 17, 18, 19]

Lect.	#.Topic	[Chapter.Section]
11	15. PDE: parabolic, hyperbolic, elliptical, discriminant	[18.2: p.943-954]
	16. PDE as a limit of system of ODEs (transmission lines)	
	17. 2^{nd} order PDE from a pair of first order ODEs	[]
12	18. Separation of variables	[2: p. 46-47; 19.2,3: p. 1017-1048; 20.2-3: p. 1058-1087]
13	21. Special Equations of Physics: Laplace, Diffusion, Wave	[18.2 p. 944-953]
14	22. Special functions, Fourier Series, Bessel, Legendre Polynomials, Rieman Zeta	
	20. Sturm-Liouville BV Theory	[17.7, p. 887-905, 20.3 p. 1029-1034]
15	23. Fourier: Integrals, Transforms, Series, DFT	[17 p. 844-942]
16	24. Laplace Transforms	[p. 1271-1275]
	19. The vector space $\mathbb{C}^1$	[9.5-7, p. 421-443]

Exam II

IV Complex Variables *(The frequency domain)* [Ch. 21, 23, 24]

Lect.	#. Topic	[Chapter.Section]
17	25. complex frequency $s \equiv \sigma + i\omega \in \mathbb{C}$ $Z(s) \in \mathbb{C}$, e^s $(e^{-i\omega T})$, $\log(s)$, $\sum_n s^n$	[Ch. 21: p. 1108-1149]
	26. Singularities, poles, branch cuts	[21.4, p. 1131-1135, 23.1-5: p. 1182-1208, 24.2: 1209-1259]
18	27. Differential calculus on $\mathbb{C}$	[]
	28. Cauchy-Riemann Eqs., Analytic functions, Harmonic functions	[24.5 p. 1240-1259]
19	29. Irrotational fields (e.g., velocity potential $\mathbf{u} = \nabla\phi(x, y, z)$)	[p. 829]
20	30. Integral calculus on $\mathbb{C}$	[]
	31. $\oint z^n dz$ on the unit circle	[22.3]
21	32. Cauchy's theorem	[]
	33. Cauchy's integral formula	[23.5]
	35. Cauchy's Residue Theorem	[24.5]
22	34. Series: Maclaurin, Taylor, Laurent	[24.3]
	36. Jordan's Lemma	[]
23	37. Inverse Transforms: Laplace $\mathcal{L}^{-1}$ and Fourier $\mathcal{F}^{-1}$	[p. 1271-1275?]
24	38. Applications of: Rational functions $\left(Z(s) = a + bs + cs^2/A + Bs\right)$ and Partial fraction expansions $Z(s) = s + a/(s + b/(s + c/(s + \cdots)))$	[p. 1263-1266]
	39. ODE's with initial condition (vs. Boundary value problems)	[]

Final

References

Abbreviations: WP: Wikipedia; COV: change of variables; BV: boundary value; p.: page; Ch.: chapter; ODE: ordinary differential equation; PDF: partial differential equation; MM: Mickey Mouse; DFT: Discrete Fourier Transform

/home/jba/Work/UIUC/ECE493/Admin/AllenSyllabus.08.tex

Version: 1.12 November 15, 2018