

# Syllabus ECE 493/Math 478

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## 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. 10, 11, 9)

- 1 Basic definitions (Ch. 10-11)
- 2 Elementary operations
- 3 Solutions to  $Ax = b$
- 4 Matrix inverse
- 5 Eigenvalue, eigenvectors
- 6 Transformations, change of basis
- 7 The vector space  $\mathbb{R}^*$  (Ch. 9)
- 8 Optimal approximationSyllabus.Levinson.08.tex

### II Advanced Calculus, (Ch. 13, 15, 16)

- 9 Partial differentiation
- 10 Line surface and volume integrals
- 11 Gradient ( $\nabla$ ), divergence ( $\nabla \cdot$ ), curl, Laplacian ( $\nabla^2$ )
- 12 The Jacobian, and change of variables
- 13 Green's, Stoke's, Divergence Theorems
- 14 Potentials and conservative fields

### III Boundary value problems (Ch. 17, 18, 19)

- 15 PDE: parabolic, hyperbolic, elliptical, discriminant
- 16 PDE as a limit of system of ODEs (transmission lines)
- 17  $2^d$  order PDE from a pair of first order ODEs
- 18 Separation of variables
- 19 The vector space  $\mathbb{C}^1$
- 20 Sturm-Liouville Theory
- 21 Wave, Laplace, Diffusion equations (again)
- 22 Special functions, Fourier Series, Bessel Functions, Legendre Polynomials
- 23 Fourier Integrals, Fourier Transforms
- 24 Laplace Transforms

#### IV Complex Variables (Ch. 21, 23, 24)

- 25  $z \in \mathbb{C}$ ,  $f(z) \in \mathbb{C}$ ,  $e^z$ ,  $\log(z)$ ,  $\sum_n z^n$
- 26 Singularities (poles)
- 27 Differential calculus on  $\mathbb{C}$
- 28 Cauchy-Riemann Eqs., analytic functions, harmonic functions
- 29 Irrotational fields (e.g., velocity potential)
- 30 Integral calculus on  $\mathbb{C}$
- 31  $\oint z^n dz$  on the unit circle
- 32 Cauchy's theorem
- 33 Cauchy's integral formula
- 34 McLaurin Series
- 35 Cauchy's Residue Theorem
- 36 Jordan's Lemma
- 37 Inverse Laplace  $\mathcal{L}^{-1}$  and Fourier  $\mathcal{F}^{-1}$  transforms
- 38 Rational functions and partial fraction expansions
- 39 ODE's with initial condition (vs. Boundary value problems)