EE 209: Transmission Line Analysis

(3 credit hours)

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Catalog Description: Fourier-Laplace transform analysis of steady-state and transient phenomena on transmission lines. Phasor representation and complex variable analysis. (3 credit hours)

Prerequisites: MATH 271

Textbook A: Murray R. Spiegel, *Theory and Problems of Complex Variables*, Schaum's Outline Series (McGraw-Hill, 1964).
Reference Text B: Robert A. Chipman, *Theory and Problems of Transmission Lines*, Schaum's Outline Series (McGraw-Hill, 1968).

COURSE OUTLINE

Lecture 1: Topic 1: Introduction to Transient Phenomena
Read Chapter 1 of texts A & B.

Lecture 2: Topic 2: Transmission Line Equations
Read Chapter 2 of Text B.

Lecture 3: Topic 2: Continued
Read Chapter 3 of Text B.

Lecture 4: Topic 3: Wave Propagation on Transmission Lines
Read Chapter 4 of Text B

Lecture 5: Topic 3: Continued

Exam #1: Topics 1–3 (10%)

Lecture 6: Topic 4: Complex Numbers: Exponential Form & Roots
Provide details for solved problems 19, 20, 28, 31, 35, 36, 38, 41, 42, 44, 45, 47, 51, 52.
Do problems 79, 87, 88, 133, 165, 166, and 168.

Lecture 7: Topic 5: Functions of a Complex Variable & Mappings
Read Chapter 2 of text A.

Lecture 8: Topic 6: Analytic Functions: Limits
Provide details for solved problems 4–6.
Do problems 57–59, 67, 68, 83, and 100.

Lecture 9: Topic 7: Analytic Functions: Continuity & Derivatives
Provide details for solved problems 9–15, 18–20, 28, 30–33, and 39–41.

Lecture 10 Topic 8: Cauchy-Riemann Equations & Differentiability
Read Chapter 3 of text A.
Provide details for solved problems 2, 4, 5, and 6.

Lecture 11 Topic 9: Polar Coordinates
Provide details for solved problems 10, 21, 22, and 24.

Lecture 12 Topic 10: Analytic Functions
Provide details for solved problems 27, 28, 37, 38, and 42.

Lecture 13 Topic 11: Harmonic Functions
Do problems 46–50, 52, 84, 109, and 115.

Exam #2: Topics 5–11 (15%)

Lecture 14: Topic 12: Voltage & Current Reflection Coefficients
Reread Chapter 4 of text B.

Lecture 15: Topic 13: Standing Waves

Lecture 16: Topic 14: Voltage Standing Wave Ratio (VSWR)
Read Chapter 4 of text A.

Lecture 17: Topic 15: Complex Integration: Contours & Contour Integrals
Provide details for solved problems 3, 4, and 6–10.

Exam #3: Topics 12–15 (15%)

Lecture 18: Topic 16: The Cauchy-Goursat Theorem
Provide details for solved problems 11, 13–18.
Do problems 64, and 75.

Lecture 19: Topic 17: Cauchy Integral Formula
Read Chapter 5 of text A.
Provide details for solved problems 1–4 and 6.
Do problems 30, 31, 34, 35, and 38.

Lecture 20: Topic 18: Derivatives of Analytic Functions
Provide details for solved problems 7–9.
Do problems 53, 57, and 83.

Exam #4: Topics 17–20 (15%)

Lecture 21: Topic 19: Maximum & Minimum Modulus Theorems
Provide details for solved problems 12–14 and 16–18.

Lecture 22: Topic 20: Poisson's Integral Formulas
Provide details for solved problems 21 and 22.

Lecture 23: Topic 21: The Fourier-Laplace Transform

Lecture 24: Topic 22: Convergence of Sequences & Series
Read Chapter 6 of text A.

Lecture 25: Topic 23: Taylor Series
Provide details for solved problem 22.

Lecture 26: Topic 24: Laurent Series
Provide details for solved problems 25, 26 and 28.

Lecture 27: Topic 25: Integration & Differentiation of Power Series, Uniqueness
Do problems 78, 79, 81, 86, 88, 92, 96, and 113.

Exam #5 Topics 22–25 (15%)

Lecture 28: Topic 26: Residue & Cauchy's Residue Theorem
Read Chapter 7 of text A.

Lecture 29: Topic 27: Isolated Singular Points, Residues at Poles
Provide details for solved problems 1–6.

Lecture 30: Topic 28: Zeros & Poles
Provide details for solved problems 7–9.

Lecture 31: Topic 29: Evaluation of Improper Integrals
Provide details for solved problems 12, 15, 18–20.
Do problems 40, 42, 44, 49, and 60.

Lecture 32: Topic 30: Improper Integrals from Fourier Analysis, Jordan's Lemma
Provide details for solved problems 24–29 and 36–37.
Do problem 75.

Lecture 33: Topic 31: Transients on Transmission Lines.

Lecture 34: Topic 31: continued

Lecture 35: Topic 31: continued

Final Exam: Topics 1–31 (30%)