Tel Aviv University
Faculty of Engineering
School of Electrical Engineering

אוניברסיטת תל אביב
הפקולטה להנדסה
בית הספר להנדסת חשמל

Wave transmission

0595.3526

Spring Semester

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COURSE TOPICS

PART I: Circuit Theory of Transmission Lines and Distributed Systems
Week 1: A general introduction to wave thewory: different wave types (electromagnetic and others); applications.
Derivation of the transmission line model and of the the Telegraph equations in the time domain. Traveling wave solutions: the concepts of wavespeed and characteristic impedance; voltage and current; power flow; dissipation; energy conservation.
Week 2: Transient solutions in lossless transmission line: reverberations.
Week 3-6: distributed circuit theory in the time harmonic regime: traveling wave solutions and power flow; reflections and standing waves; input impedance. Smith Chart. Measurements in transmission lines. Matching networks: quarter wavelength, stub mating (one two and triple)). Pulse propagation and dispersion: phase and group velocities.

PART II: Electromagnetic Theory of Transmission Lines
Week 7-8: EM waves in transmission line (TEM modes): Review of Maxwell's Equations; derivation of the transmission line model; examples of electromagnetic systems
Week 8-9: EM waves in waveguides: Derivation of the transmission line equations for TE and TM modes in general configurations. Example: rectangular waveguides.

PART III: Plane Waves
Week 10-11: Electromagnetic plane-waves: The wave equation in free space; plane wave solutions; polarization. Plane wave reflection and transmission at in multi-layered media: Transmission line analog. Angular spectrum of plane waves. Radiation from an aperture.

PART IV: Introduction to Radiation

Week 12-13: Radiation: The Herzian dipole. Near vs far fields. Arrays of Herzian dipoles. Far field approximation, radiation patters, interference.

ASSIGNMENTS

There will be 8 homework assignments 75% of all homework assignments must be handed in for evaluation. In addition there will be 4 mandatory MATLAB project that count toward 20% of the final grade. Student will be examined on each project.

MIDTERM COURSE POLICY

The 2 hours midterm will count for 15% of the total course grade, if the mideterm grade is higher than that of the final exam, and will not be counted if the grade is lower. Students are permitted to bring only a basic calculator and 4 pages of formulas (no solved examples) written by the student.

FINAL COURSE POLICY

The final 3 hours exam will cover the entire course material and will count for 65% to 80% of the total course grade, depending if the midterm grade is counted or not. Students are permitted to bring to the exam only a basic calculator and 4 pages of formulas (no solved examples) written by the student.

BIBLIOGRAPHY

1. Sophocles J. Orfanidis, *Electromagnetic waves and antennas*, 2014. Free download from http://www.ece.rutgers.edu/~orfanidi/ewa/
2. S. Ramo, J. R. Whinnery, T. Van Duzer, *Field and waves in communication electronics*, Wiley, 1984
3. U.S. Inan and A.S. Inan, *Electromagnetic waves*, Prentice Hall, 2000.
4. C.T.A Johnk, *Engineering lectromagnetic fields and waves*, Wiley, 1988.
5. R. E. Collin, *Foundations for microwave engineering*, 2nd Edition, McGraw-Hill, 1992 (or Wiley-IEEE Press 2000).
6. D. M. Pozar, *Microwave engineering*, 4th Edition, Wiley 2012 (1st Edition, 1998).