ECE 201C COURSE SYLLABUS SPRING 2003

Antennas and Radiation

UNIVERSITY OF CALIFORNIA AT SANTA BARBARA
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

This course covers the fundamentals of electromagnetic radiation and wave propagation required for a sound understanding of antennas and their use in modern high-frequency systems. Important analytical and numerical techniques are discussed and applied to commonly used antenna structures. These include the use of Green's functions and the Method of Moments (MoM) for solving integral equations. The practical use of transmitting and receiving antennas in terrestrial microwave links, radar, remote sensing, satellite communications, and radio anstronomy is covered, including the effects of noise. Planar antennas which can be fabricated by modern monolithic processing techniques will be discussed, as these are becoming increasingly important in modern millimeter-wave electronics. A solid background in classical electromagnetic theory is required, such as found in ECE 144A-B and/or ECE 201A-B. The level of mathematics and computation in this course requires a computer for most problems of practical interest, and students are encouraged to learn and make use of programs like *Mathematica* and *Matlab* for the homework.

The grade will be based on homework assignments and either a term project or a take-home final. The term project might involve a theoretical or experimental investigation (better yet, both) of a radiating structure or experimental apparatus, or application of the methods learned in the course to the students current research interests. Past projects in this class have resulted in published journal papers. Since I want the project to be significant, homework assignments will be less cumbersome this quarter than in 201A-B.

PREREQUISITES:	ECE 201A-B, or exceptional students from 144A-B or equivalent
INSTRUCTOR:	Bob York, Room 5113, Engineering I, x7113
TIME AND PLACE:	M-W 8:00 AM-10:00 AM, Room 1437, Phelps
TEXTBOOK:	The main course text is **Antenna Theory: Analysis and Design** 2nd ed. by C.A. Balanis Wiley, 1997 Call no. TK7871.6.B353 but any other antenna book will do. One possibility is **Antennas and Radiowave Propagation** by R.E. Collin McGraw Hill, 1986
GRADING:	Homework 60% Project/Final 40%
OFFICE HOURS:	by appointment

Bibliography

Electromagnetic Theory

- S. Ramo, J. R. Whinnery, T. Van Duzer, *Fields and Waves in Communication Electronics, 2nd Ed.*, Wiley, New York, 1984. The best book on electromagnetics (at the intermediate level) ever written for engineers.
- R. F. Harrington, *Time-Harmonic Electromagnetic Fields*, McGraw-Hill, New York, 1961. Standard EM textbook at UCSB.
- J. D. Jackson, *Classical Electrodynamics, 2nd ed.*, Wiley: New York, 1975. Written primarily for physicists, using Gaussian units and $e^{-i\omega t}$ time dependence, this book is a storehouse of analytical techniques for electromagnetics.
- J. A. Kong, *Electromagnetic Wave Theory, 2nd ed.*, Wiley Interscience: New York, 1990. An excellent, modern presentation of electrodynamics with a great collection of problems.

Antenna Theory

- K. F. Lee, *Principles of Antenna Theory*, Wiley: New York, 1985. Short and sweet.
- R. E. Collin, *Antennas and Radiowave Propagation*, McGraw-Hill: New York, 1985. Concise coverage of both antennas and propagation; a good reference book.
- J. D. Kraus, *Antennas, 2nd. Ed.*, McGraw-Hill: New York, 1988. A very practical book by a leading experimentalist in the field.
- W. L. Stutzman and G. A. Thiele, *Antenna Theory and Design*, Wiley: New York, 1981.
- C. A. Balanis, *Antenna Theory: Analysis and Design*, Harper & Row: New York, 1982.
- S. Silver, *Microwave Antenna Theory and Design*, McGraw Hill: New York, 1949; reprinted by Peter Perigrinus, 1984. Once was the book on antennas, now a bit dated but still useful.
- R. C. Hansen, *Microwave Scanning Antennas*, Peninsula Publishing: Los Altos, CA, 1985. Originally a three volume work from Academic Press. Very detailed, rigorous treatment of arrays and aperture antennas from the pre-computer era.
- Kristen Rohlfs, *Tools of Radio Astronomy*, Springer Verlag: Berlin, 1986. Excellent reference for antennas in low noise receiver systems.
- G. E. Evans, *Antenna Measurement Techniques*, Artech House: Boston, 1990.

Planar Antennas

- D. B. Rutledge, D. P. Neikirk, and D. P. Kasilingam, "Integrated Circuit Antennas", in *Infrared and Millimeter Waves*, vol. 10, K. J. Buton, Ed., New York: Academic Press, 1983. A classic, much used reference.
- P. Bhartia, K. V. S. Rao, and R.S. Tomar, *Millimeter-Wave Microstrip and Printed Circuit Antennas*, Artech House: Boston, 1991.
- J. R. James and P. S. Hall, eds, *Handbook of Microstrip Antennas*, Peter Peregrinus Ltd., London, 1989. Comprehensive two-volume work describing just about every possible variation of microstrip antenna.

Computational Electromagnetics

- R. E. Collin, *Field Theory of Guided Waves*, McGraw-Hill Book Company, New York, 1960. Although not strictly a computational electromagnetics text, this book has an excellent chapter on Green's functions.
- R. F. Harrington, *Field Computation by Moment Methods*, Macmillan: New York, 1968. The standard reference on method of moments, although now a bit dated.
- T. Itoh, ed., *Numerical Techniques for Microwave and Millimeter-wave Passive Structures*, Wiley Interscience: New York, 1989. An excellent book describing the most important techniques, written for professionals.
- M. N. O. Sadiku, *Numerical Techniques in Electromagnetics*, CRC Press: Boca Raton, 1992. A new introductory book, written for students.
- Press *et al.*, *Numerical Recipes*, Cambridge University Press, New York, 1989. Should be on every graduate students desk.