

ECE 521 Surface Mount Technology

- Catalog Data:** Surface Mount Technology (3-0)
Credit Hours: 3
Prerequisites: ECE 221
Introduction to Surface Mount Technology (SMT). Effective implementation of circuit board designs to address technical issues in SMT. A study of solid-state devices and digital circuits. Technical discussions will explore advantages and disadvantages of SMT; SMT processes and equipment; design tools and guidelines; internal circuit structure and device operation; and defect analysis.
- Textbooks:** Richard C. Jaeger, Travis N. Blalock, 2003. Microelectronic Circuit Design, Second Edition, McGraw-Hill

James K. Hollomon, Jr., 1995. Surface Mount Technology for PC Boards, First Edition, Prompt.
- Reference Text:** Clyde F. Coombs, Jr., 2001. Printed Circuits Handbook, Fifth Edition, McGraw-Hill.
- Coordinator:** Deborah M. Dawson, Instructor, ECE

Prerequisites by topic:

1. Junction Theory
2. Semiconductor diode and models
3. Bipolar transistors and models
4. Field-effect transistors and models
5. Semiconductor circuits, biasing and stabilization
6. Computer-aided design of single- and two-stage amplifiers
7. Principles and basic technology of MOS and bipolar digital and linear integrated circuits

Objectives:

1. Understand terminology, advantages, and disadvantages of SMT.
2. Understand circuit structure and device operation.
3. Understand impact electronic design has on components, materials, and quality.
4. Understand SMT manufacturing processes and equipment.
5. Understand defect analysis
6. Understand design tools and guidelines for manufacturability and for test
7. Study logic design.
8. Improve problem-solving skills.

Topics:

1. Historical view of electronics, electronics packaging, benefits and limitations of SMT.
2. Semi-conductor material, components: surface mount and thru-hole.
3. Printed circuit board design process, manufacturing methods and specifications.
4. Solid state devices, electrostatic discharge.

5. Diode circuits, SMT manufacturing methods.
6. OrCad Schematic Capture.
7. Design process, manufacturing documentation, FETS.
8. Land pattern design, digital electronics.
9. Soldering methods and design for solderability.
10. OrCad layout requirements, design review.
11. Test and design for testability, MOS logic design.
12. Defect analysis and quality assurance in SMT.
13. PCB acceptability and reliability, CMOS logic design.
14. SMT design projects.

Computer usage:

Students should be familiar with MATLAB (available in the CAE Center) for homework assignments. Class projects will require the use of OrCad software package.

Evaluation:

1. Midterm Exams 30%
2. Final Exam 25%
3. Class Project 30%
4. Homework & Quizzes 15%

Performance Objectives:

1. Students will be able to analyze the best type of technology to use for any given design. They will be able to understand parametric trade-offs for components and the impact of ESL and ESR on high-speed designs.
2. Students will be able to state the process steps necessary for building printed circuit boards. They will analyze the benefits of various materials available and provide specifications as part of their final design project.
3. Students will be required to use OrCad software for schematic capture and board layout. They will be required to enter the project data and then apply design guidelines for manufacturability, reliability, testability, and quality assurance in order to create a robust design. Appropriate use of design tools will be demonstrated.
4. Students will demonstrate an ability to formulate the requirements for doping concentrations to control electrons and holes in solid state materials.
5. Students will demonstrate the ability to apply device modeling (and the different levels of modeling) to achieve various approximations to the I - v characteristics for solid state diodes and FETs.
6. Students will be able to use equations to calculate noise margins, rise and fall times, propagation delays and power consumption of digital circuits.
7. Students will understand the design process for circuit boards and will be able to generate a complete manufacturing documentation package that includes industry standard files.
8. Students will be able to distinguish between various levels of acceptability for IPC classifications.
9. Students will conduct design reviews on projects to determine if manufacturability, reliability, testability, and quality assurance needs have been met.

