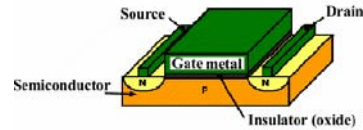
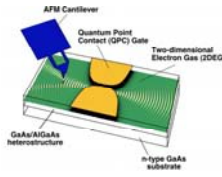


PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL ENGINEERING
ELEG 6433 – SEMICONDUCTOR DEVICES
COURSE SYLLABUS
SPRING Y2K+7



"The difficulty lies, not in the new ideas, but in escaping the old ones, which ramify, for those brought up as most of us have been, into every corner of our minds."

- John Maynard Keynes

"We are at the very beginning of time for the human race. It is not unreasonable that we grapple with problems. But there are tens of thousands of years in the future. Our responsibility is to do what we can, learn what we can, improve the solutions, and pass them on."

- Richard P. Feynman

"There is at least one point in the history of any company when you have to change dramatically to rise to the next level of performance. Miss that moment - and you start to decline."

- Andrew S. Grove

Professor: Dr. A. Anil Kumar
Office: Room 330C, New Science Building
Phone: (936) 857-2591 (Office), (281) 890-0848 (Home)
E-mail: aakumar@pvamu.edu
Lectures: Friday 2:00 P.M. - 4:50 P.M., NENR 117, Electrical Engineering Building
Office hours: By appointment
Books for the course: Any book on semiconductor devices will serve the purpose. The following list will serve as a start. The main part of the course - field effect devices - is covered exceedingly well in: R.F. Pierret, *Field Effect Devices*, Volume IV from the *Modular Series in Solid State Devices*, 1990, Addison-Wesley.

Supplementary Material: General Texts

1. *Fundamentals of Modern VLSI Devices*, Y. Taur & T. H. Ning, Cambridge University Press, 1998
2. *Field Effect Devices and Applications*, D. W. Greve, Prentice Hall, 1998
3. *Understanding Semiconductor Devices*, Sima Dimitrijevic, Oxford University Press, 2000
4. *Semiconductor Devices*, by J. Singh, McGraw Hill, 1994
5. *Semiconductor Devices*, by M. Zambuto, McGraw Hill, 1991
6. *Advanced Semiconductor Fundamentals*, by R.F. Pierret, Addison-Wesley, 1988

Supplementary Material: Reference Books

1. *The Practicing Scientist's Handbook*, by A. Moses, Van Nostrand Reinhold, 1978
2. *Semiconductor Devices and Integrated Electronics*, by A.G. Milnes, Van Nostrand Reinhold, 1980
3. *Encyclopedia of Physics*, by R.G. Lerner & G.L. Trigg, VCH Publishers, 1991
4. *CRC Handbook of Materials*, CRC Press, most recent edition
5. *The New York Times' Circuits - How Electronic Things Work*, Ed. Henry Fountain, St. Martin's Press, 2001

COURSE DESCRIPTION

The purpose of this course is to provide you with the knowledge and techniques that are central to an understanding of the performance of semiconductors and semiconductor-based devices, at the micro- and smaller levels. The lectures will outline the latest advances in semiconductor devices, discuss simple analytical models, and most importantly, emphasize the importance of modeling device behavior. Specifically, we will discuss the operation and modeling of basic bipolar and unipolar devices, including: p-n junctions,

Schottky diodes, BJTs, MOS-C, MOSFETs, HEMTs, and semiconductor interfaces. Also included is a discussion of circuit-level and systems-level components that gives an overview of CMOS standard cells and functional blocks such as basic inverters and memory cells, optoelectronic devices, photonic devices, and quantum devices. Reliability aspects of these devices under operation will also be briefly discussed.

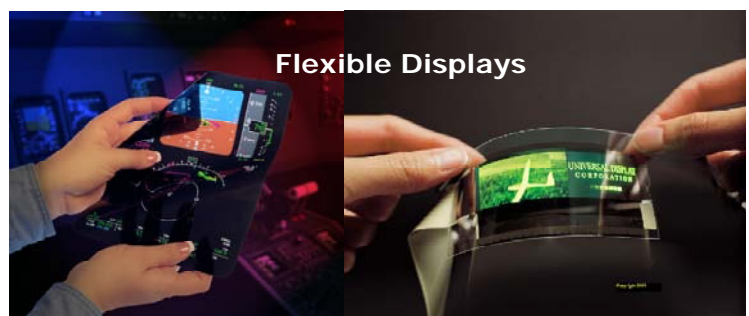
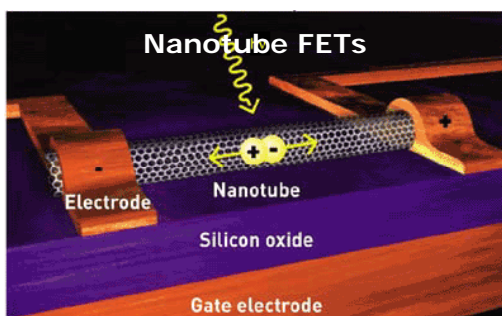
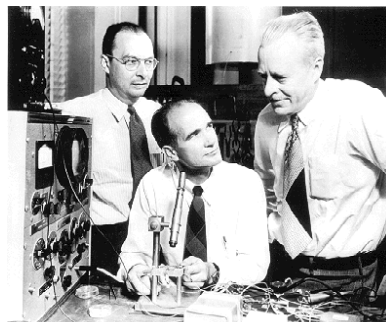
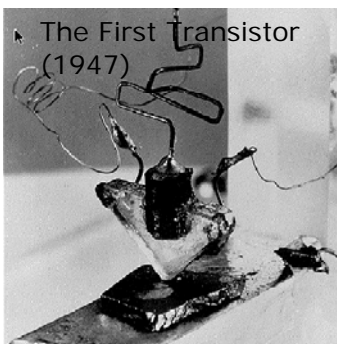
GOALS

By the end of the course, you should be able to, at a minimum:

- demonstrate an understanding of known device building blocks and associated mathematical modeling techniques;
- compute relevant macroscopic quantities (current, capacitance, conductance, power, etc.) in terms of microscopic quantities (carrier densities, doping concentrations, etc.);
- correlate the changes in microscopic parameters to the macroscopic behavior of a given device/system;
- develop a systematic approach to small circuit/system modeling;
- qualitatively analyze small circuits such as logic gates and memories in terms of the behavior of their device components; and
- predict qualitative and quantitative behavior of novel devices in various configurations.

TOPICS COVERED

Introduction & Motivation; Review from Quantum Theory and Solid State Physics; Basic review of semiconductor physics and relevant equations; Very Large Scale Integrated (VLSI)/Ultra Large Scale Integrated (ULSI) Device Technologies; p-n Junctions; Bipolar Junction Transistor (BJT); Junction Field Effect Transistor (JFET); Metal Oxide Semiconductor Capacitor (MOS-C); Metal Oxide Semiconductor Field Effect Transistor (MOSFET); Complementary Metal Oxide Semiconductor (CMOS) Devices; Devices and Circuits - inverters, sensors, charge coupled devices (CCDs), memories; Novel Solid State Devices - superconducting junctions, ferroelectric memories, non-traditional semiconductors; Special Topics - reliability and fault-tolerance, failure mechanisms, electromigration, radiation effects, noise, thermal effects, microelectromechanical systems (MEMS), quantum devices (number of topics will depend upon available time).



PERFORMANCE EVALUATIONS

Homework

I will be assigning several problems throughout the semester. However, I will assume a certain level of maturity and independence from you. In other words, I will not be "policing" you. However, student notebooks should be maintained regularly and will be evaluated at the end of the course. These notebooks should include, at a minimum: examinations, take home assignments, homework problems, other worked out problems and design project papers.

Examinations

There will be two examinations - a mid-term and a final.

Technical Papers

Three technical papers are required during the semester.

1. A review of a device - its origin, evolution, impact and future
2. Profiles of two companies involved in the IC design, manufacturing and utilization
3. A Term Paper, to be submitted at the end of the semester, on a topic related to the class material. You are expected to make a presentation on your project to the class during the last two weeks of the semester. Details will be discussed in the class.

Special Presentation

You will be given a published paper/report. You are expected to review the paper/report and present the review to the class.

Panel Discussions

From time to time, panel discussions will be held. The purpose of these discussions will be to become aware of the broader environment of the semiconductor device field including the technological, commercial, social and global considerations. Details will be discussed in the class.

ATTENDANCE POLICY

Class will start and end at the prescribed times. Attendance in every class is expected and is the student's responsibility. Absence or tardiness may result in lowered grades. Excessive absenteeism, whether EXCUSED or UNEXCUSED, may result in a student's course grade being reduced or even an assignment of a grade of "F". Absences are accumulated beginning with the first day of class. The 2005-2007 University Graduate Catalog, especially page 95 (Academic Information and Regulations), provides more detailed information. You must make yourself familiar with pages 94 to 100 of this catalog. Also refer to page 18 of the **Registration and Term Information Spring 2006** booklet.

GRADING POLICY

Your grade, in particular the final grade, will be determined on a combination of your examination performance, design projects and your participation in the class: asking questions, working out problems, making suggestions toward alternative ways of solving the same problem - in other words, behaving like students, not like stenographers. In order to obtain a proper grade, I need to be convinced that you have acquired the necessary knowledge from the course. The following is the overall grade distribution among the various types of assignment.

Mid-Term Examination	15%	
Technical Papers (2)		25%
Term Paper	20%	
Homework/Notebooks/Class Performance		5%
Special Presentation		10%
Panel Discussions	5%	
Final Examination	20%	

No makeup examinations will be given except in cases of emergency. No "I"s will be given, unless the stringent conditions specified in the University Catalog are satisfied.

STUDENTS WITH DISABILITIES

All lectures will be conducted in the New Science Building, Room 320, which is accessible to persons with disabilities. If you need accommodations in this class related to a disability, please make an appointment with me as soon as possible. My office is located in Room 330C, New Science Building. There is an Office of Disability Services on the campus located in Evans Hall Room 315, Tel: (936) 857-2610. More information is provided on Pages 5 and 39 of the **Registration and Term Information Spring 2007** booklet, available online at <http://www.pvamu.edu:80/pages/2112.asp>.

CONDUCT AND ETHICS

A strict code of ethics will be imposed in the class and in the examinations. It is a sign of impoliteness and disrespect to your professor and to your colleagues if you make a practice of coming to the class late. Absolutely no talking or cheating will be permitted during the examinations. You shall take a pledge that you will not copy, steal or plagiarize someone else's work nor will you tolerate anyone else doing the same. It shall be the policy in this course to discourage any such activity to the extent possible rather than punish. **HOWEVER, IN FAIRNESS TO ALL CONCERNED, CHEATING AND PLAGIARISM WILL BE DEALT WITH SEVERELY WHEREVER THEY ARE FOUND.** You are advised to read and abide by the rules and the regulations of the University as mentioned in the Catalog, in particular the topics Student Life and Academic Regulations. Graduating means more than completing a certain number of hours and obtaining a reasonable GPA. You must strive to develop a code of strict conduct, acquire a sense of discipline, serve as a role model to your juniors and in particular experience the feeling of accomplishment.

If you have any questions or have any problems that you think I may be able to help with, please do not hesitate to contact me. I am here to help. Learning does hurt. But I am here to make it hurt a little less.

HAVE A PRODUCTIVE AND AN ENJOYABLE SEMESTER!