## Spring 2017 Special Topics

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New Course Offering for Spring Quarter 2017
“Electromagnetic Metamaterials” (EEC289K)

Date/Time/Location TR 4:40-6:00 pm Olson 251
Instructor Dr. J. Sebastian Gomez-Diaz

The purpose of the course is to build up a basic understanding in several advanced topics of electromagnetic metamaterials and metasurfaces, and to gain knowledge in cutting-edge research that covers multidisciplinary areas of electrical engineering, physics, and material science.

Tentative Course Outline

1. Review of Electromagnetic Theory

2. Anisotropic and Dispersive Media

3. Bulk Metamaterials and Applications

4. Ultrathin Metasurfaces and Applications

Prerequisites
Familiarity with electromagnetics and high level programming.

Design Project
Analyze, model, and fabricate (if possible) recent metamaterial-based devices available in the literature.

About the Instructor
J. Sebastian Gomez-Diaz is an Assistant Professor in the Electrical and Computer Engineering Department of the University of California, Davis. He received his Ph.D. degree in electrical engineering (with honors) from the Technical University of Cartagena (UPCT, Spain) in 2011. From October 2011 until March 2014 he was a postdoctoral fellow at the École Polytechnique Fédéral de Lausanne (EPFL, Switzerland). Then, from May 2014 to August 2016, he continued his postdoctoral work in the Metamaterials and Plasmonic Research Laboratory of The University of Texas at Austin (US). He has co-authored >50 journal papers, some of them published in highly selective journals such as Nature Communications, Physical Review Letters, and IEEE Transactions/Letters, and >60 conference papers. His main research interests include multidisciplinary areas of electromagnetic wave propagation and radiation, metamaterials and metasurfaces, plasmonics, novel 2D materials, antennas, and non-linear optics.

https://sites.google.com/site/jsebastiangomezdiaz/
EEC289 - Electromagnetic metamaterials

4 units – Spring Quarter

**Lecture**: 3 hours

**Project**: 1 hour

**Prerequisite**: EEC230 – Electromagnetics is recommended

**Grading**: Letter; homework (15%), midterm (20%), design project (25%), final exam / design project II (40%)


**Expanded course description**: The purpose of this course is to build up a basic understanding in the analysis, design and practical applications of electromagnetic metamaterials and metasurfaces from microwaves to optics.

I. Review of electromagnetic theory
   A. Introduction
   B. The Maxwellian framework for bulk and 2D materials
   C. Isotropic, chirality and reciprocity
   D. Passive, active, and non-linear materials
   E. Examples of wave propagation

II. Electrodynamics of anisotropic and dispersive media
   A. Poynting vector
   B. Dispersion and Kramer-Kronig relations
   C. Wave propagation in left-handed media
   D. Waves through NRI slabs: Negative refraction and the perfect lens
   E. Indefinite and uniaxial media
   F. Ferrites and Faraday rotation

III. Bulk metamaterials and applications
   A. Synthesis of metamaterials
   B. Homogenization
   C. Optical metamaterials and applications: Cloaking, ENZ, and HMTMs
   D. Metamaterials at microwaves and guided and radiative applications
   E. Breaking time-reversal symmetry

IV. Ultrathin metasurfaces and applications
   A. Generalized laws of reflection and refraction
B. Graphene and 2D materials
C. Plasmonics in metasurfaces
D. Hyperbolic, non-linear and non-reciprocal responses

Textbook/reading:

Most material will be from class and recent research papers on electromagnetic metamaterials and metasurfaces.

1. C. A. Balanis, Advanced engineering electromagnetics
2. D. Jackson, Classical electrodynamics
3. P. Yeh, Optical waves in layered media
4. S. A. Tretyakov, Analytical modeling in applied electromagnetics
5. R. Marques et al, Metamaterials with negative parameters
6. N. Engheta et al, Metamaterials: physics and engineering explorations
7. C. Caloz et al, Electromagnetic Metamaterials: Transmission line theory and microwave applications

Instructor: J. S. Gomez-Diaz
2017 SQ 289L SYLLABUS

289L: Compound Semiconductor Materials and Device Presentations and Discussions
Location: OLSON 151
Time: MW 2:10 – 4:00 p.m.
Format: Lectures given by students: MW 2:10-3:30 p.m.
Student discussions M-W 3:40-4:00 p.m.
Course Credit: 4 units for each student.
Instr: Jerry Woodall: Distinguished Professor of ECE
       jwoodall@ucdavis.edu
Office: 2001 Kemper Hall
Hours: Tues. 1:30-4:30

Course purpose and goals:

The purpose and goals of this course are to provide a detailed knowledge of all aspects of compound semiconductor materials and devices. The students who are enrolled in the course will teach the course. The goal of this method is to give each and every student the practice and experience of both learning and teaching a course and improving public speaking skills, and team skills in organizing lectures.

How the course will operate:

1. Two students will be paired in alphabetical order of last name and be assigned a topic in order from the list in the syllabus (see next page).
2. Each student of the partnership will present one component of a comprehensive lecture derived from research from textbooks, journals, and the web to prepare the lecture on the topic assigned to the partnership. The presentation format will be a classroom projected ppt or pdf file. Each partnership will decide among themselves what material and which day they will present.
3. For each class a 1 hour 20 minute formal presentation will be given. After a 10 minute break, a 20 minute class Q&A/discussion will occur. Any one who has an unexcused miss of any discussion will receive a maximum letter grade of a B.
4. The student giving the class lecture must turn into the instructor an e-file of the lecture immediately following the class.

Grading:

Lecture 85%: grade metrics include: comprehensiveness, clarity, grammar, style, staying on target of teaching the assigned topic, etc.
Discussion 15%: Participation in discussion of other student lectures, e.g. asking important questions, adding comments for completeness or clarity, etc. (All students taking the SQ 2016 course got at least an A-). Class attendance is mandatory. Any unexcused absence will result in a reduction of one letter grade for the course.

Note: Enrollment is capped at 20 students.
Drop Outs: all drop-outs must notify Prof. Woodall of this intention by the end of the Wednesday class of the first week. There will be no drop-outs allowed after that date.

Swapping team members or topics: All students may swap pair wise topics and/or pair wise individual partners in advance of the scheduled presentation of the swapped topics. The date or order of topic presentation cannot be changed.

**Weekly Compound Semiconductor Topics:**

1. First class  
1.1 Introductory remarks Prof. Woodall  
1.2 Review and current status of solar cells.
2. Overview of current and past use/applications of compound semiconductor materials and devices  
3. Review and current status of LEDs  
4. Review and current status of injection lasers  
5. Review and current status of BJTs and HBTs  
6. Review and current status of MESFETs and MOSFETS  
7. Review and current status of photodetectors (excluding PVs)  
8. Review and current status of specialty devices, including, RTD, cascade lasers, superlattice devices, etc.  
9. Review and current status of special device and materials processing considerations including doping, selective etching, surface and interface Fermi level pinning, MOS-C, lift off, device isolation, LED, laser, photodetector, solar sell, HEMT and HBT fabrication  
10. Review and current status of 2-D materials and devices
Filters are ubiquitous components in high frequency electronic systems. Jokingly known as the “RF engineers’ bandage”, RF and microwave filters find use in band/channel selection, image rejection, anti-aliasing, and pretty much anywhere undesired signals need to be eliminated. This course intends to provide a thorough and up-to-date overview of the design theories and implementation techniques for RF and microwave filters. The targeted audience is senior undergraduate students and graduate students with a basic background in circuit analysis and RF engineering.

The topics covered in this course include:

- Review of network analysis and synthesis techniques
- Filter approximations and prototype synthesis
- Frequency and impedance transformations
- Coupled resonator filters and the coupling matrix
- Design of microstrip and waveguide filters
- Mechanical and micro-mechanical filters
- Tunable filters and wide-band filters
Course Title: Integrated Circuit Design for Power Electronics

Spring Quarter 2017
TR: 2:10pm-4:00pm

Description: IC design for power electronics. Linear and switching regulation. Integrated power management. DC/DC and AC/DC conversion. Applications in portable electronics and wireless sensors.
EEC289R- Special Topics in Computer Architecture

Spring Quarter 2017

Units - 4

Lecture: 4 hours  (Scheduled as 2 2-hour lecture blocks)

Prerequisite: 270 or 201A

Grading: Letter; project (40%) assignments (20%), term papers (25%) and presentation (15%)

Catalog Description

Computer architecture for extremely high performance and extremely low power applications such as Scalable Data Analytics, Internet of Things, and Brain-Machine interfaces in an era when CMOS scaling is coming to an end.

Expanded Course Description

1) Computer Architecture in the Post Moore’s Law Era
   a. Accelerators/Dedicated Circuits eg: FPGA, ASICs,
   b. In memory processing
   c. Approximate Computing

2) Computer Architecture for Ultra low Power applications
   a. Asynchronous Design
   b. Near Threshold Computing

3) Architecture for Emerging Applications
   a. Scalable Data Analytics
   b. Internet of Things
   c. Brain Machine Interfaces
Textbooks: None

Course will be based on recent papers from leading journals and conferences in the topics covered.

Instructor: Akella

THIS COURSE DOES NOT DUPLICATE ANY EXISTING COURSE.