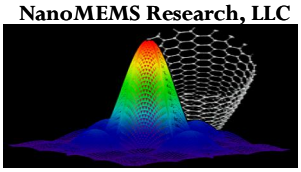
NanoMEMS Research, LLC



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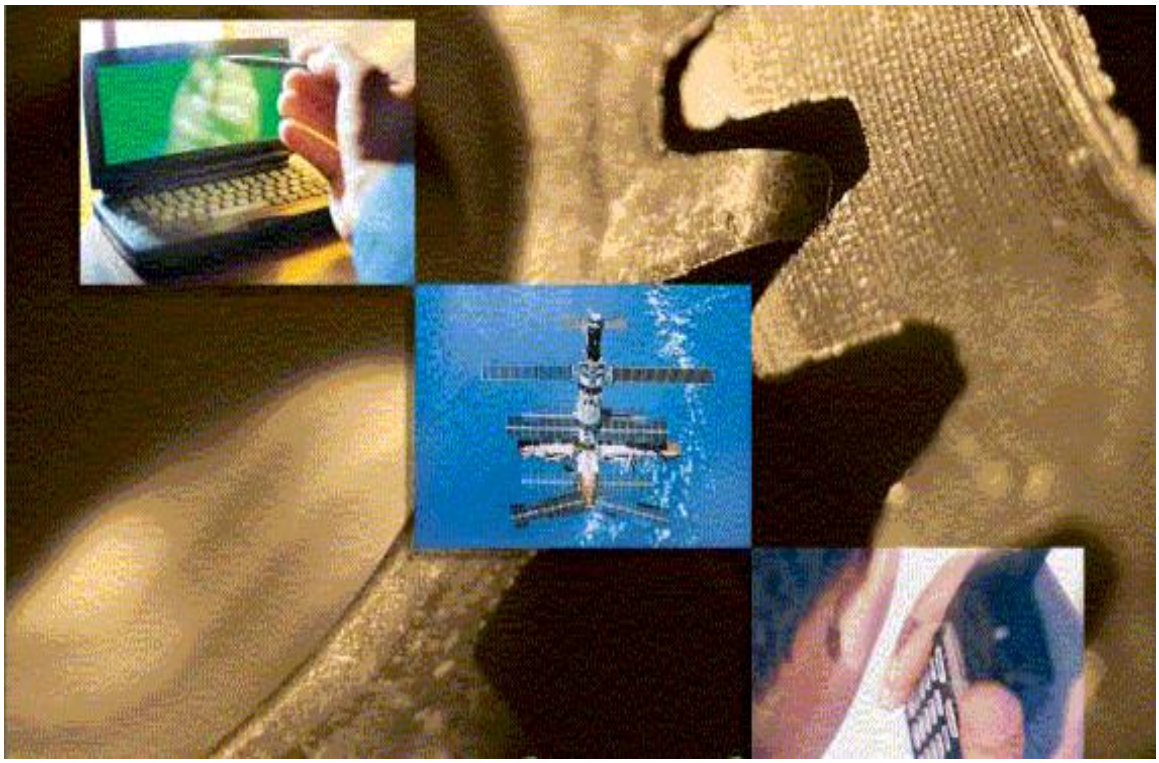

Catalog Continuing Education Courses

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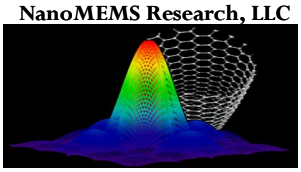

Introduction to RF/Wireless MEMS Technology and Commercialization

Course Summary

Microelectromechanical Systems (MEMS) applications in RF and microwave electronics are on the verge of revolutionizing wireless communications. In this course we discuss the fundamentals of this exciting technology, potential pitfalls to be encountered, and typical applications where MEMS is expected to make the greatest impact in RF/microwave circuits and systems. In particular, the ability of MEMSô fabrication techniques to enhance the performance of passive components, e.g., capacitors, inductors, transmission lines, and switches, is addressed, and a number of potential wireless system opportunities, namely, wireless transceivers, routing networks, and tracking antennas for mobile multimedia communications, awaiting the maturation of MEMS, are discussed.

Who Should Attend: Students, engineers, designers, manufacturers, marketing and business development managers, and executives currently involved in the study, development, or manufacturing of wireless systems for both commercial and defense markets.

Course Objectives

This course aims at getting interested parties informed on:

- Motivation behind RF/Wireless MEMS Technology
- The fundamentals Physics of RF MEMS Devices
- Fundamental applications of RF MEMS to Devices, Circuits and Systems
- Opportunities for RF MEMS Insertion and Commercialization

Course Outline

1 Overview of Microelectromechanical Systems
MEMS Origins. MEMS Fabrication Technologies

2 Fundamental MEMS Device Physics
Actuation. Mechanical Vibrations. Computer-Aided Design of MEMS

3 Fundamental MEMS Devices: The MEM Switch
The Cantilever Beam MEM Switch. MEM Switch Design Considerations

4 Fundamental MEMS Devices: The MEM Resonator
The Cantilever Beam MEM Resonator. MEM Resonator Design Considerations

5 Microwave MEMS Applications
MEM Switches. Micromachining-Enhanced Planar Microwave Passive Elements.
MEM Resonators

6 MEMS-Based Microwave Circuits and Systems
Wireless Communications Systems. MEMS-Based RF and Microwave Circuits

7 RF/Wireless MEMS Insertion and Commercialization

Number of Hours Required for Completion: 6 hours

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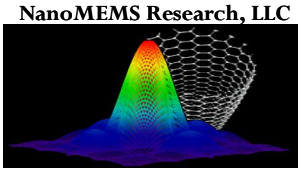

RF MEMS Circuit Design for Wireless Communications

Course Summary

Microelectromechanical systems (MEMS) technology is on the verge of revolutionizing RF and Microwave wireless applications. As the requirements of present day and future wireless systems for lower weight, volume, power consumption and cost with increased functionality, frequency of operation and component integration become more and more demanding, the potentialities of the RF MEMS arsenal to meet these requirements, by enabling new wireless components and system architectures, are becoming ever more attractive. In this course we address the key practical aspects on which one must be well versed to succeed in exploiting this technology as well as its salient emerging applications.

Who Should Attend: Students, engineers, designers, manufacturers, marketing and business development managers, and executives currently involved in the study, development, or manufacturing of wireless systems for both commercial and defense markets.

Course Objectives

This course aims at getting interested parties informed on:

- Motivation for applying RF MEMS in Wireless Systems
- The elements of RF Circuit Design
- The nature of Circuit Elements Enabled by RF MEMS and Their Applications
- Case Studies on the Application of RF MEMS Devices in Circuit Design for Wireless Systems

Course Outline

1. Wireless Systems—A Circuits Perspective

2. Elements of RF Circuit Design
Physical Aspects of RF Circuit Design. Practical Aspects of RF Circuit Design

3. RF MEMS-Enabled Cicruit Elements and Models
RF/Microwave substrate properties. Micromachined-Enhanced Elements
MEM switches. Resonators. MEMS modeling

4. Novel RF MEMS-Enabled Circuits
Reconfigurable Circuit Elements. Reconfigurable Circuits. Reconfigurable Antennas

5. RF MEMS-Based Circuit Design—Case Studies
Phase Shifters. Filters. RF MEMS oscillators.

Number of Hours Required for Completion: 6 hours

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Fundamentals of Nanotechnology

Course Summary

The fundamentals of the field of nanotechnology are introduced, in particular, the main fabrication challenges and opportunities at the nanoscale, together with the emerging approaches to mass production.

Who Should Attend: Students, engineers, designers, manufacturers, marketing and business development managers, and executives who are curious about why nanotechnology has elicited so much interest (e.g. NSFôs National Nanotechnology Initiative) and is perceived by many as the foundation for the next industrial revolution.

Course Objectives

This course aims at getting interested parties informed on:

- The main fabrication challenges and opportunities at the nanoscale
- The approaches to mass production at the nanoscale
- The plethora of potential applications of nanotechnology

Course Outline

1. **Fabrication Techniques**
2. **Imaging and Manipulation Tools at the Nanoscale**
3. **Nanoscale Devices and Circuits**

Number of Hours Required for Completion: 3 hours

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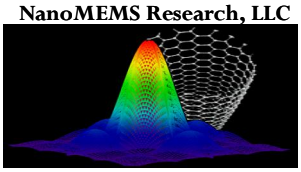

MEMS in RF and Microwave Electronics

Course Summary

Microelectromechanical Systems (MEMS) applications in RF and microwave electronics are on the verge of revolutionizing wireless communications. In particular, RF MEMS promises to endow wireless handsets, base stations and satellites with the key properties of low-power consumption and reconfigurability, which in turn will enable superior functionality and performance. In this course, a comprehensive exposition of the state-of-the-art in MEMS technology applied to RF devices, circuits and systems is given. The topics to be presented include: RF MEMS fabrication technology, MEMS Actuators, Passive devices (Transmission Lines, Capacitors, Inductors, Switches, Varactors, Resonators), Circuits (Filters, Oscillators, Phase Shifters, Couplers), Systems (Transceivers, etc.)

Who Should Attend: Students, engineers, designers, manufacturers, marketing and business development managers, and executives currently involved in the study, development, or manufacturing of wireless systems for both commercial and defense markets.

Course Objectives

This course in aims at getting interested parties informed on:

- RF MEMS fabrication processes, devices, circuits, systems, packaging, reliability and CAD
- How to apply RF MEMS technology to create superior wireless systems
- How to evaluate competing RF MEMS devices and technologies in light of your capabilities, applications and budget.
- How to identify opportunities for RF MEMS insertion in wireless applications.

Outline

1 Overview of RF MEMS Technology and Applications

2 RF MEMS fabrication technology
Fabrication techniques. Materials available. Technologies for microwave and millimeter wave applications: Bulk and surface micromachining. Fabrication of movable MEMS. Power handling
issues. 3D integration of MEMS with IC's.

3 Passive Devices
Transmission Lines. Capacitors. Inductors. MEM Switches. Varactors.

4 RF MEMS Phase Shifters

5 RF MEMS-Based Resonators, Filters and Oscillators

6 FBAR Resonators and Applications

6 RF MEMS Packaging

7 RF MEMS Reliability

8 RF MEMS-Based Architectures & Front-Ends

Number of Hours Required for Completion: 18 hours

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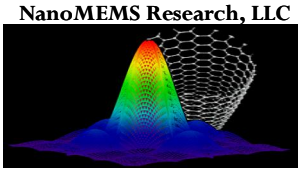

Hands-On RF MEMS Design

Course Summary

This course introduces the student to the methodology and tools utilized in the design of RF MEMS. In particular, by utilizing a case-study as learning vehicle, the student is given a practical ñhands-onò opportunity to learn and exercise the CAD tools commonly used to conduct the mechanical and electromagnetic design aspects of an RF MEMS device. The student will be provided with temporary licenses to mechanical and electromagnetic simulators.

Who Should Attend: Students, scientists and engineers, with a background in conventional RF/microwave design, who wish to expand their knowledge to include RF MEMS design, and those with a background in the general MEMS field who wish to learn about RF MEMS design.

Course Objectives

This course aims at getting interested parties informed on:

- RF MEMS Device Physics
- RF MEMS mechanical design
- RF MEMS electromagnetic design

Outline

1 RF MEMS Devices
Physics. Electrostatic Implementations. Design Methodology.

2. RF MEMS Mechanical Design
Layout. Meshing. Problem Setup. Actuation. Resonance Frequencies. Visualization

3. RF MEMS Electromagnetic Design
Layout. Problem Setup. S-Parameters Simulation. Visualization

Number of Hours Required for Completion: 18 hours

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