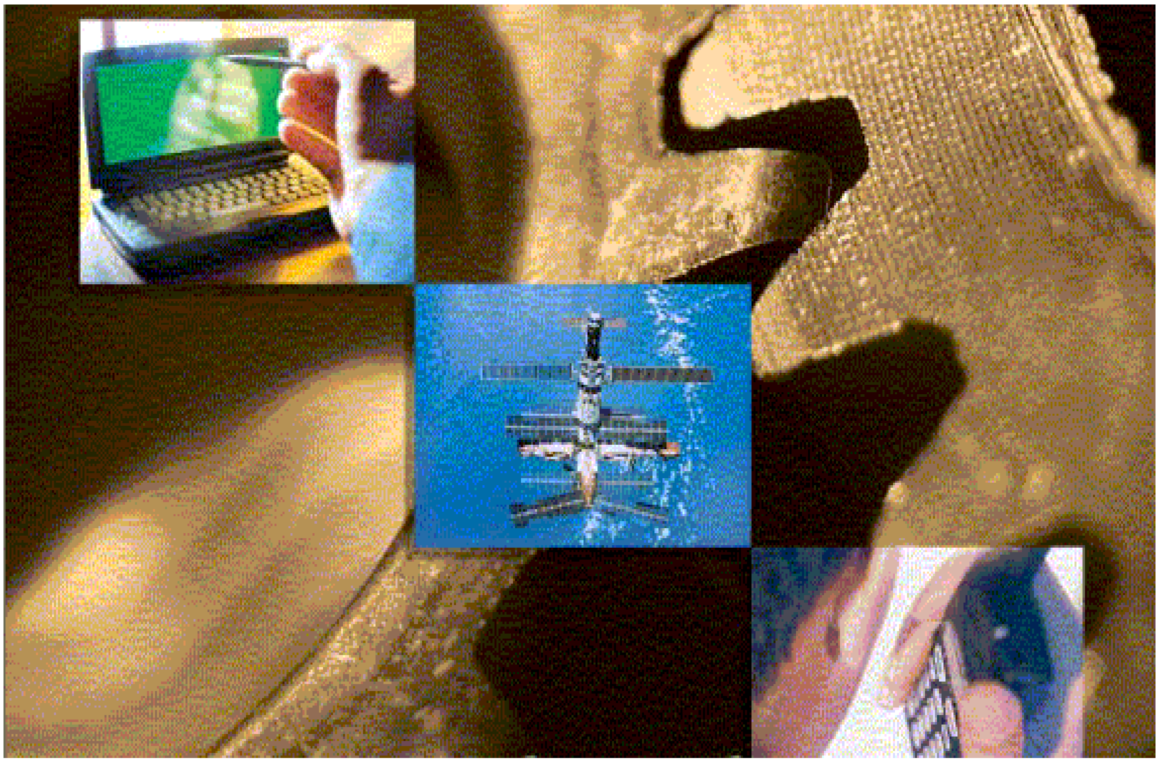
NanoMEMS Research, LLC
Let's Seize The Future.Today!



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 MEMS' 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 commercial 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

Duration: This is a ONE-DAY Course.

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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 commercial 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.

Duration: This is a ONE-DAY Course.

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 commercial 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

Duration: This is a THREE-DAY Course.

Modern Radio Systems Engineering

Course Summary

The course is aimed at upper-level undergraduates/first-year graduate students, who already have knowledge of devices and circuits for radio-frequency (RF) and microwave communications and are ready to study the systems engineering-level aspects of modern radio communications systems. In particular, the course gives a general overview of radio systems, together with their components. In this context, the focus is on the analog parts of the system, with their non-idealities. Based on the physical functionality of the various building blocks of a modern radio system, block parameters are derived, which allows the examination of their influence on the overall system performance.

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 commercial markets.

Course Objectives

This course in aims at getting interested parties informed on:

- Understanding the wireless communications problem and its solutions and modern applications such as 5G, Internet of Things (IoT), etc.
- Understanding of information modulation and detection techniques.
- Understanding of radio system parameters.
- Understanding of radio channel fundamentals and antennas.
- Transceiver architectures.
- Case studies.

Outline

1. Introduction to Radio Systems
1.0 Overview of Wireless Communication Systems
1.1. Simplified Block Diagram of Transmitter and Receiver
1.2 Basic Modulation Definitions in Mathematical Terms
1.3 Spectral Properties of the Basic Modulation Schemes

2. Modulation and Detection
2.1 AM Modulators
2.2 AM Demodulators
2.3 FM Modulators
2.4 FM Demodulators
2.5 PM Demodulators
2.6. Digital Modulation
2.7 Complex Envelope Form of Modulation Signals

3. Typical System Performance Parameters
3.1 Transmitter
3.2 Receiver
3.3 System Components

4. Radio Channel Fundamentals and Antennas
4.1 Wireless Radio Channel
    4.1 1 Radio Transmitter and Receiver Block Diagram

4.1.2 Wave Propagation Phenomena
4.1.3 Multi-Path Propagation
4.2 Description of Antennas and Their Parameters

5. Noise, Nonlinearity and Time Variance
5.0 Introduction
5.1 Thermal Noise
5.2 Shot Noise
5.3 Noise Bandwidth
5.4 Signal-to-Noise Ratio
5.5 Available Noise Power
5.6 Noise Figure
5.7 Nonlinearity and Time Variance

6. Sensitivity and Dynamic Range
6.0 Introduction
6.2 Sensitivity
6.2.1 Minimum Detectable Signal
6.2.2 Signal-to-Noise Ratio
6.2.3 1-dB Compression Point
6.2.4 Intermodulation Distortion
6.2.5 Cascaded Receiver Networks
6.3 Dynamic Range
6.3.1 Receiver Blocking
6.3.2 Spur-Free Dynamic Range

7. Transceiver Architectures
7.0 Introduction
7.1 Transmitter Architectures: Heterodyne
7.2 Transmitter Architectures: Homodyne
7.3 Receiver architectures: Heterodyne
7.4 Super-heterodyne Receiver—Dual IF Topology
7.5 Homodyne (Zero IF/Direct-Conversion) Receiver
7.6 Transmitter Leakage
7.7 Receiver Architectures—Image-Reject
7.7.1 Hartley Architecture
7.8 Oscillators— Phase noise, oscillator pulling and pushing

8. Case Studies

Duration: This is a FOUR (preferably FIVE) -DAY Course.

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NanoMEMS in High-Frequency Technology and Electronics

Course Summary and Objectives

This course introduces the novel field of nanoelectromechanical quantum circuits and systems. The field derives from exploiting progress in techniques for fabricating, down to nanometer-length scales, free-standing device structures that incorporate mechanical motion and that may be designed to perform a variety of functions, such as employed in microwaves, and, in particular, mechanical and mixed domain. The ability to create these nanomechanical structures, in turn, brings within our reach a tremendous possibility for both creating superior implementations of conventional circuits and systems, as well as entirely new ones. Since novel quantum mechanical effects, for instance, quantized heat flow, manifestation of charge discreteness, and the quantum electrodynamical Casimir effect, become operative in this regime, exciting new paradigms for circuit modeling and design must be invoked in order to fully exploit the potential of this technology in sensing, computation, and signal processing applications.

Key markets of applicability include: Cell Phones, Terrestrial and Satellite Communications, Computers, and Instrumentation Equipment.

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 commercial markets.

Outline

1. Introduction
   - NanoMEMS Origins
   - Elements of Wireless Systems
2. NanoMEMS Fabrication Principles
   - Overview of conventional IC Fabrication
   - MEMS Fabrication
   - Nanoelectronics Fabrication
3. Nanoscale Imaging and Manipulation Techniques
   - Scanning Probe Microscopy
   - Scanning Tunneling Microscopy
   - AFM-based Nanomanipulation
4. NanoMEMS Physics
   - Electrostatic Actuation
   - Piezoelectric Actuation
   - Quantum Wave-Particle Phenomena
     - van der Waals Force
     - Casimir Force
   - Quantum Information Theory, Computing and Communications
     - Quantum Entanglement
     - Quantum Teleportation
     - Decoherence
   - Quantum Wave Phenomena
     - Manifestation of Wave Nature of Electrons
     - Quantum Resonance Tunneling
     - Photonic Band-Gap Crystals (PBC)

- Quantum Transport Theory
    - Fermi Liquids and Lüttinger Liquids
    - Fermi Gas
    - Fermi Liquids
    - Lüttinger Liquids

5. RF MEMS-Enhanced Planar Microwave Passive Elements
    - Transmission Lines
    - Lumped Elements
6. RF MEMS Devices
    - RF MEMS Switches
    - RF MEMS Varactors
7. RF MEMS-Based Reconfigurable Circuits & Systems
    - Matching Networks
    - Phase Shifters
    - Antennas
8. Emerging RF MEMS/Nanotechnology (NanoMEMS) Applications
    - Carbon Nanotubes
        - Devices
        - Circuits
        - Antennas
    - Casimir Effect Oscillator
    - Quantum Computing Paradigms
    - Near-Field Scanning Optical Microscopy (NSOM/SNOM)
    - Plasmonics

Duration: This is a FOUR (preferably FIVE)-DAY Course.