JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE) – III-II Sem **L T P C**

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(19A04605a) INTRODUCTION TO WIRELESS AND CELLULAR COMMUNICATIONS

PROFESSIONAL ELECTIVE-II

Course Objectives:

- To be familiar with evolution of Wireless communication standards
- To understand cellular concepts and various terminology used in wireless & cellular communications
- To analyze the propagation effects in free space and different types of fading channels.
- To be able to apply different concepts of equalization and diversity schemes for better performance of receivers.
- To understand and apply the knowledge of 3G and 4G communication technologies for desiging suitalble receivers to counter balance the effects of fading channels

Unit 1: Overview of Cellular Systems and evolution: Introduction, Mobile Radio Systems around the world and US, examples of wireless communication systems, Comparison and trends in wireless communication systems, Evolution of 2g/3G/4G/5G Communication Standards.

Cellular Concepts – Frequency reuse, Cochannel and Adjacent channel Interference, C/I, Handoff, Blocking, Erlang Capacity, Improving coverage and capacity in cellular systems.

Unit 2: Wireless propagation Part 1: Link budget, Free-space path loss, Noise figure of receiver, Large Scale Propagation effects.

Wireless propagation Part II: Small scale multipath propagation, Multipath fading, Shadowing, Fading margin, shadowing margin, Channel Models.

Unit 3: Equalization & Diversity: Introduction, Types of equalization techniques, Diversity Schemes -Antenna Diversity, Time Diveristy.

Unit 4: Multiple Access Techniques: Introduction, Types of access techniques, Wireless Channel Capacity, Introduction to MIMO.

Unit 5: CDMA Part1 – PN codes, generation, properties, CDMA PartII, OFDM and LTE Part I OFDM and LTE Part II.

Course Outcomes:

- CO1: Understand different technologies used in the evalution of wireless communication standards.

- CO2: Apply the concepts of frequency reuse, fading channel characteristics, equalization and diversity techniques to find the solutions for a given problem.
- CO3: Analyze the performances of different technologies used in 2G, 3G standards of wireless communication.
- CO4: Solve some complex problems to design receivers due to small scale fading, effects of the chnnel.
- CO5: Compare various technologies used in different generations of wireless communication to know the merits and dermerits of eache technology.

Text Books:

1. T. S. Rappaport, "Wireless Communications – Principles and Practice" (2nd edition) Pearson, 2010, ISBN 9788131731864
2. A. Molisch, "Wireless Communications," Wiley, 2005Haykin & Moher, "Modern Wireless Communications" Pearson 2011 (Indian Edition)
3. J. G. Proakis, "Digital Communications," McGraw Hill
4. A. Goldsmith, "Wireless Communications," Cambridge Univ Press, 2005
5. D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge Univ Press, 2005

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(19A04605b) FABRICATION TECHNIQUES FOR MEMS-BASED SENSORS: CLINICAL PERSPECTIVE

PROFESSIONAL ELECTIVE-II

Course Objectives:

- To be familiar with microengineering devices, clean room, metallic impurities and wafer cleaning process.
- To understand the principles of MEMs based sensors and different technologies used in the fabrication process.
- To know the design process flow for fabricating microengineering devices, Process flow for microheater
- To understand process flow for Fabricating Flexible Force Sensors, Force Sensors on Silicon, and Fabricating VOC sensors,

Unit 1: Introduction to microengineering devices and its applications, Clean room, contaminants, wafer cleaning processes (DI water, RCA, metallic impurities, etc.).

Unit 2: Introduction to the microheater, force sensors, microfluidic devices, its specifications, and applications, Masks - Types of masks, Types of Photoresists, Spin Coaters Lithography process: optical lithography, x-ray, and e-beam lithography, lift-off techniques, soft lithography, Use of resists (spin coating, positive and negative photoresists), photoresist pre-baking, exposure, and development.

Unit 3: Etching: Isotropic/anisotropic, selectivity, wet and plasma assisted etching, Types of wafers and orientations, Techniques of metallization: PVD [(Sputtering – DC, RF, and Magnetron), thermal evaporation, e-beam evaporation], Chemical Vapor Deposition: Dielectric films (Plasma Enhance Chemical Vapor Deposition (PECVD)), Atomic Layer Deposition.

Unit 4: Understanding and designing the process flow for fabricating microengineering devices, Process flow for microheater, force sensors, and microfluidic devices, Wafer dicing and bonding techniques, Microfluidic Chips.

Unit 5: Process Flow for Fabricating Flexible Force Sensors and Force Sensors on Silicon, Process Flow for Fabricating VOC sensors, Biochips, Clinical Research: Problems and Solutions using Microengineering Device, Visit to non-conventional Class 10000 Clean Room and discussing few equipment within.

Course Outcomes:

- **CO1**: Unnderstand the principles of MEMs based sensors, clean room, types of wafers, and different technologies used in the fabrication process.

- **CO2**: Analyze theprocess flow for Fabricating Flexible Force Sensors, Force Sensors on Silicon, and Fabricating VOC sensors.
- **CO3**: design process flow for fabricating microengineering devices, Process flow for microheater.

Books and references

1. J.D. Plummer, M.D. Deal, P.G. Griffin, Silicon VLSI Technology, Pearson Education, 2001.
2. S.A.Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2001. S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill, 1988
3. Senturia S. D., Microsystem Design, Kluwer Academic Publisher, 2001 Madou, M Fundamentals of Microfabrication, CRC Press, 1997.
4. Gad-el-Hak, M., Ed., The MEMS Handbook; CRC Press: New York, NY, 2002.

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(19A04605c) INTEGRATED PHOTONICS DEVICES AND CIRCUITS

PROFESSIONAL ELECTIVE-II

Course Objectives:

- To be familiar with Photonic Integrated Circuits, multimode waveguides, various types of directional couplers, and CMOS Compatible Silicon Photonics Technology.
- To understand the concepts of coupled mode theory, fiber to waveguide converters, and directional couplers.
- To analyze the functionality of multimode waveguides, various types of directional couplers Reconfigurable Filters and Tunable Delay Lines, and FPPGAs.
- To design single mode, multimode waveguides, bends, and photonic crystal waveguides and Integrated Optical High-Speed Modulators.

Unit 1: Introduction to Photonic Integrated Circuits – Functional Building Blocks; Theory of Optical Waveguide – The Basic Building Block; Orthogonality Condition of Guided Modes, Introduction to Photonic Integrated Circuits – Functional Building Blocks; Theory of Optical Waveguide – The Basic Building Block; Orthogonality Condition of Guided Modes.

Unit 2: Design Principle of Single-Mode and Multimode Waveguides: Channel and Ridge/Rib waveguides, Waveguide Bends; Slot and Photonic Crystal Waveguides, Design Principle of Single-Mode and Multimode Waveguides: Channel and Ridge/Rib waveguides, Waveguide Bends; Slot and Photonic Crystal Waveguides.

Unit 3: Coupled Mode Theory; Waveguide Distributed Bragg Reflector (DBR) and Sub-Wavelength Grating (SWG) waveguide; Adiabatic Mode-Size Converter (MSC), Fiber-to-Waveguide, Vertical Grating Coupler (VGC), Coupled Mode Theory; Waveguide Distributed Bragg Reflector (DBR) and Sub-Wavelength Grating (SWG) waveguide; Adiabatic Mode-Size Converter (MSC), Fiber-to-Waveguide Vertical Grating Coupler (VGC).

Unit 4: Directional Coupler (DC), Multi-Mode Interferometric Coupler (MMIC). Mach-Zehnder Interferometer (MZI) and Microring Resonator (MRR): Filters and Delay Lines, Directional Coupler (DC), Multi-Mode Interferometric Coupler (MMIC). Mach-Zehnder Interferometer (MZI) and Microring Resonator (MRR): Filters and Delay Lines. Practical Planar Lightwave Circuits and CMOS Compatible Silicon Photonics Technology Platforms; Thermo-Optic and Electro-Optic Switches; Reconfigurable Filters and Tunable Delay Lines, Concept of Field Programmable Photonic Gate Array (FPPGA).

Unit 5: Practical Planar Lightwave Circuits and CMOS Compatible Silicon Photonics Technology Platforms; Thermo-Optic and Electro-Optic Switches; Reconfigurable Filters and

Tunable Delay Lines, Concept of Field Programmable Photonic Gate Array (FPPGA), Integrated Optical High-Speed Modulators Design and Working Principle.

Course Outcomes:

- CO1: Get familiarity with Photonic Integrated Circuits, multimode waveguides, various types of directional couplers, and CMOS Compatible Silicon Photonics Technology.
- CO2: Understand the concepts of coupled mode theory, fiber to waveguide converters, and directional couplers.
- CO3: Analyze the functionality of multimode waveguides, various types of directional couplers Reconfigurable Filters and Tunable Delay Lines, and FPPGAs.
- CO4: Design single mode, multimode waveguides, bends, and photonic crystal waveguides and Integrated Optical High-Speed Modulators.

Books and references

1) Silicon Photonics – An Introduction, G.T. Reed (Wiley)

2) Photonics: Optical Electronics for Modern Communication, Yariv and Yeh (Oxford)

3) Optoelectronic Integrated Circuit Design and Device Modeling, Jianjun Gao (Wiley)

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(19A04605d) ELECTRICAL MEASUREMENT AND ELECTRONIC INSTRUMENTS
PROFESSIONAL ELECTIVE-II

Course Objectives:

- To remember the basic definitions of some important measurement parameters of electrical and electronic instruments.

- To understand the basic principles of different measuring meters (voltage, current, and other passive parameters), CROs, and transducers.
- To apply the knowledge of DC and AC meters while solving problems related to measurement errors.
- To analyze the performance of various electric and electrionc instruments like energy meters, analog & digital meters, CROs, function generators and signal generators.

- To design the AC& DC multi-meters function generators and function generators for the given specifications.

Unit 1: Measurement Error, Accuracy and Instrument grades, Electro-mechanical instruments, electromechanical ammeters, voltmeters and ohmmeters.

Unit 2: Electromechanical wattmeter and energy meter, Resistance Measurement, Impedance Measurement: AC Bridges, Potentiometers: DC and AC, Instrument transformers: CT & PT.

Unit 3: Magnetic Measurement, Analog Instrumentation Basics, Analog Instrumentation, Digital Instrumentation Basics, Digital Instrumentation, Signal and Function Generators, Spectrum Analyzer.

Unit 4: Oscilloscope and Electronic probes: Introduction, Block diagram of CRO, Electron beam generation, Deflection Assembly – Horizontal and Vertical amplifiers and associated blocks, Digtal CRO, basic principle, types of digital CROs, Probes – types of probes and associated principles.

Unit 5: Transducers: Introduction, types of transducers – Strain guage, LVDT, Inductive and capacitive transducers, electromechanical transducers.

Course Outcomes:

- CO1: Remember the basic definitions of some important measurement parameters of electrical and electronic instruments.

- CO2: Understand the basic principles of different measuring meters (voltage, current, and other passive parameters), CROs, and transducers.

- CO3: Apply the knowledge of DC and AC meters while solving problems related to measurement errors.
- CO4: Analyze the performance of various electric and electrionc instruments like energy meters, analog & digital meters, CROs, function generators and signal generators.

- CO5: Design the AC& DC multi-meters function generators and function generators for the given specifications.

Books and references

1. Electronic Instrumentation and Measurements: David A. Bell

2. A course in Electrical and Electronic Measurements and Instrumentation: A. K. Sawhney

3. Basic Electrical Measurements: M B Stout

4. Electrical Measurements and Measuring Instruments, E.W Golding, F.C Widdis

5. Electronic Measurements and Instrumentation: William David Cooper.

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(19A04605e) PRINCIPLES AND TECHNIQUES OF MODERN RADAR SYSTEMS

PROFESSIONAL ELECTIVE-II

Course Objectives:

- To understand the basic principles of RADAR and its varients, RADAR based Microwave imaging.
- To apply the fundamental knowledge of various RADARs, Matched Filter and to find the range between the target and RADAR, frequency and phase of the received signal.
- To analyze the received data from the target using CW RADAR & MTI RADAR and to find the distance, tracking range for clutter analysis.

Unit 1: Basic Principles: Fundamental elements of Radar and its block diagram, Radar equation – Signal to Noise Power Ratio (SNR), Radar Cross section – Cross sections of small targets, Examples of target cross sections, cross section fluctuations and models.

Unit 2: CW Radar – Principle, block diagram, FMCW Radar, Pulsed Radar Principles, Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar, range measurement.

Unit 3: Tracking in Radar, Frequency measurement and tracking, Angular resolution, Monopulse Technique, Detection Theory: Match Filtering, Radar Ambiguity Function.

Unit 4: Imaging Radar: Resolution Concept, Pulse Compression, Synthetic Aperture Processing, ISAR Imaging, Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models.

Unit 5: Ground Penetrating Radar for close sensing**,** Radar Tomography and Radar based Microwave Imaging, Emerging and Modern Applications of Radar Principles.

Course Outcomes:

- CO1: Understand the basic principles of RADAR and its varients, RADAR based Microwave imaging.
- CO2: Apply the fundamental knowledge of various RADARs, Matched Filter and to find the range between the target and RADAR, frequency and phase of the received signal.
- CO3: Analyze the received data from the target using CW RADAR & MTI RADAR and to find the distance, tracking range for clutter analysis.

Books and references

1. Introduction to Radar Systems, M.I. Skolnik, 3rdEdition, Tata Mcgraw hill edition, 2001

2. Radar Systems Analysis and Design using MATLAB, B.R.Mahafza, 3rd Edition, CRC Press, 2013.

3. Radar Principles, Peyton Z. Peebles, Jr., Wiley India, 2008.

4. Monopulse Principles and Techniques, S.M.sherman and D.K.Barton, 2ndEdition,Artech house, 2011

5. Fundamentals of Radar Signal Processing, M.A.Richards, TMH, 2005

6. Ground Penetrating Radar: Theory and Applications, Ed: H.M. Jolt, Elsevier, 2009

7. Microwave Imaging, M.Pastorino, John Wiley, 2010