NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	MTech Semiconductor Technology
Course Code:	6EC362CC24
Course Title:	MEMS Design & Technology
Course Type:	Departmental Elective
Year of Introduction:	2024-25

L	T	Practical component				C
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Course Learning Outcomes (CLOs)

At the end of the course, students will be able to

1. Comprehend the concepts of advanced Micro/Nano fabrication technologies (BL3)
2. analyse different techniques and process for microsensor (BL4)
3. apply MEMS in area of optical, modulators, switches, displays (BL4)
4. design RF MEMS switches, relays, Varactors, phase shifter, antennas (BL5)

	Contents	Teaching hours (Total 45)
Unit I	**Advanced Micro/Nano Fabrication Technologies** Plasma physics, ICP etch, Deep Si etch, Deep oxide etch, Surface micromachining, Bulk micromachining: multiple wafer stack, SOI, SCREAM, CMOS-MEMS: Thin-film, bulk, DRIE, CMOS-based Sensors and Interface Circuits Design	**08**
Unit II	**Optical MEM** Fundamentals of light: Propagation, Interference, Doppler Effect, Polarization, Coherence, Chemical, Thermal, Inertial, Interface circuit design, Micromirrors, Micro-lens, Micro-gratings Corner cube reflectors, Optical communications	**08**
Unit III	**MEMS Phase Modulators** Fundamental of MEMS based Phase Shifter, N-bit shunt and series phase shifter, switch-line phase shifter, loaded line phase shifter, Varactor and Switched capacitor phase shifter, Phase shifter based on Antenna feed, Phase modulators, attenuators, switches, Displays, Scanners, Biosensors, Spectroscopy, Biomedical Imaging, RF MEMS	**09**
Unit IV	**RF MEMS** Basic Switches, Switches for RF and Microwave application, actualtion mechanism for RF MEMS devices, basic of Micro Relays bistable micro relay and micro actuators, MEMS varactors and inductors, RF MEMS capacitors, RF MEMS phase shifters and filters, Micro machined transmission line and components	**10**
Unit V	**MEMS Packaging**	**05**

	Packaging design, materials, Packaging techniques: Bonding, Sealing, Dicing, Wafer-level packaging, Packaging for medical, aerospace and RF MEMS applications	
UnitVI	**MEMS based Sensor** Pressure sensors, acceleration and angular rate sensors, flow sensors based on resistive, piezoelectric and electrostatic (capacitive) effects using bulk and surface micromachining approaches, Resonant sensors.	**03**
UnitVII	**Case Study** recent research on RF MEMS switches, RF MEMS attenuators, RF MEMS resonators.	**02**

Self Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/References:

1. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill
2. S. Senturia, Microsystem Design, Kluwer Academic Publishers
3. M. Madou, Fundamentals of Microfabrication, Chemical Rubber Company Press
4. G. Rebeiz, RF MEMS: Theory, Design and Technology, John Wiley & Sons
5. B. Bouma and G. Tearney, Handbook of Optical Coherence Tomography, Marcel Dekker Inc