NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering
Course Code:	3EC603ME24
Course Title:	MEMS Design and 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 advanced Micro/Nano fabrication technologies. BL-2
2. apply different techniques and processes for the development of microsensor. BL-3
3. appreciate the role of MEMS in area of optical, modulators, switches, displays. BL-2
4. design RF MEMS switches, relays, varactors, phase shifter, antennas for the given specification. BL-6

Unit No.	Contents	Teaching hours (Total 45)
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
II	**Optical MEMS:** Fundamentals of light: propagation, interference, doppler effect, polarisation, coherence, chemical, thermal, inertial, interface circuit design, micromirrors, micro-lens, micro-gratings corner cube reflectors, optical communications	08
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	10
IV	**RF MEMS:** Basic Switches, Switches for RF and microwave application, actuation 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
V	**MEMS Packaging:** Packaging design, materials, packaging techniques: bonding, sealing, dicing, wafer-level packaging, packaging for medical, aerospace and RF MEMS applications	04
VI	**Case Studies:** Recent research on RF MEMS switches, RF MEMS attenuators, RF MEMS resonators.	05

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.

Suggest List of Tutorials (not restricted to the following):
(Only for information)

Sr. No.	Title of the Tutorials	Hours
1.	Introduction to Tool - Coventor ware	01
2.	Introduction to Tool - HFSS	01
3.	Beam Design of Series type MEMS switch	01
4.	Beam Design of Shunt type MEMS switch	01
5.	Modal and Harmonic Analysis of the series type MEMS switch- 1	01
6.	Modal and Harmonic Analysis of the series type MEMS switch- 2	01
7.	Evaluate Contact, Pull-in, and Lift-off voltage of the series type MEMS switch- 1	01
8.	Evaluate Contact, Pull-in, and Lift-off voltage of the series type MEMS switch- 2	01
9.	Evaluate Contact, Pull-in, and Lift-off voltage of the series type MEMS switch- 3	01
10.	Find frequency and transient response of the series type MEMS switch- 1	01
11.	Find frequency and transient response of the series type MEMS switch- 2	01
12.	Design low activation shunt type switch	01
13.	Design low activation and K band shunt type MEMS switch	01
14.	Design resonator using MEMS switch	01
15.	Design phase shifter using MEMS sensors	01

Suggested Readings:

1. G. Kovacs, Micromachined Transducers Sourcebook, Tata 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 publication
5. B. Bouma and G. Tearney, Handbook of Optical Coherence Tomography, Marcel Dekker Inc