	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Master of Technology in VLSI and Embedded Systems**	Year of Regulation	**2018-19**
Department	**Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EC 514	**INTRODUCTION TO MEMS AND MICROSYSTEMS**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		
	Familiar with the fundamentals, fabrication process and applications of MEMS and Microsystems		CO1	Ability to understand the operation of micro devices, micro systems and their applications
	Understand the basic principles of MEMS sensors and actuators		CO2	Able to design MEMS devices based on various sensing and actuation mechanisms
	Understand various materials used in MEMS		CO3	Able to identify materials and fabrication processes to develop MEMS devices
	Understand the MEMS fabrication process and manufacturing		CO4	Able to design electronic circuits for MEMS device

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1	CO1	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**0**
2	CO2	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**0**
3	CO3	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**1**	**0**	**0**
4	CO4	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**1**	**0**	**0**

SYLLABUS

No.	Content	Hours	COs
I	Overview of MEMS and Microsystems: Introduction to MEMS and Microsystems, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microelectronics and Microsystems, Applications of MEMS.	4	CO1
II	Working Principles of MEMS and Microsystems: Introduction to Microsensors and Microactuators, Sensing techniques for MEMS: Piezoresistive, Piezoelectric, Capacitive and Optical sensing methods, Microactuation techniques for MEMS: Actuation methods using Thermal forces, Piezoelectric crystals and Electrostatic forces, Examples of MEMS based Microsensors and Microactuators.	12	CO2
III	Materials and Fabrication Processes for MEMS and Microsystems: Materials: Substrates and Wafers, Active Substrate Materials, Silicon as a Substrate Material, Silicon Compounds, Gallium Arsenide, Quartz, Piezoelectric Crystals, Polymers, Packaging Materials, Fabrication processes: Photolithography, Diffusion, Ion Implantation, Oxidation, Chemical Vapor Deposition, Physical Vapor Deposition – Sputtering, Deposition by Epitaxy, Dry and Wet Etching Techniques, Micromachining processes: Bulk and Surface Micromachining, The LIGA Process.	12	CO3
IV	Electronic circuits for MEMS and Microsystems: Semiconductor devices: Diodes, BJT, MOSFET, CMOS, Electronic Amplifiers, Operational amplifiers, Difference amplifier, Wheatstone Bridge circuit for measurement of resistance, Analog to Digital converter, Differential charge measurement, Switched capacitor circuits for capacitance measurement.	8	CO4
	Total Hours	36	

Essential Readings

1. T.R. Hsu, “MEMS and Microsystems: Design and Manufacture”, McGraw Hill, 1st Edition, 2002.
2. M.H. Bao, “Analysis and Design Principles of MEMS Devices”, Elsevier, 1st Edition, 2008.
3. M.J. Madou, “Fundamentals of Microfabrication: The Science of Miniaturization”, CRC Press, 2nd Edition, 2002.

Supplementary Readings

1. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Aatre, “Micro and Smart Systems”, Wiley India, 1st Edition, 2010.
2. S.D. Senturia, “Microsystem Design”, Springer, 1st Edition, 2001.