



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3172014

Semester – VII

Subject Name: MEMS and Nanotechnology

Type of course: Engineering Science (Professional Elective – III)

Prerequisite: Zeal to learn the subject

Rationale: The subject is used for understanding the concepts and techniques related to design and manufacturing of MEMS components. It will be useful to attain a broad range of the knowledge required to flourish in the rapidly developing field of Nanotechnology.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	1	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	Introduction to MEMS and Micro Systems: MEMS and Microsystems, Typical MEMS and Micro system Products, Evolution of Micro fabrication, Microsystems and Microelectronics.	5
2	Working Principles of Microsystems: Introduction, Micro sensors, Micro actuators, Micro accelerometers, Static bending of thin plates, Mechanical Vibration, Thermo mechanics, Fracture mechanics, Thin Film mechanics, Scaling laws.	7
3	Micro system Materials: Molecular Theory and Intermolecular Forces – Silicon Piezo Resistors, Substrates and Wafers, Silicon Compounds, Polymers.	3
4	Micro system Fabrication Process: Photolithography, Ion Implantation, Diffusion, Chemical Vapor Deposition, Physical Vapor Deposition	8
5	Basics of Nanotechnology and applications: Nanobuilding Blocks, Atoms and Molecular Structure, Molecular Recognition, Tools For Measuring Nanostructures, Electron Microscopy, Nanomaterials, Applications of nanomaterials.	5



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Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	30	15	15	10	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Tai, Ran Hsu, "MEMS & Microsystems Design & Manufacture", Tata Mc Graw Hill, 2002
2. Richard Booker, Earl Boysen, "Nanotechnology", Wiley Dreamtech (p) Ltd, 2006
3. Mart Ratner, Daniel Ratner, "Nanotechnology", Pearson Education, 2003
4. Charles P. Poole. "Introduction to nanotechnology," Wiley publications, 2003
5. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
6. The MEMS Hand book, Mohamed Gad-el-Hak, CRC Press, New York, London

Course Outcomes:

After successful completion of the course the students shall be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Attain a broad range of the knowledge required to flourish in the rapidly developing field of MEMS and Nanotechnology.	25
CO-2	Facilitate the application of basic physical laws, chemical laws, dynamic behavior as well as steady state performance to design and synthesize MEMS and Microsystems.	25
CO-3	Acquaint him / her with applications of MEMS fabrication techniques and Nanotechnology to solve the problems encountered at a macro level.	25
CO-4	Gain Proficiency in Modeling, simulating and evaluating MEMS and Microsystems.	25



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List of Tutorials:

1. Introduction to MEMS & Microsystems.
2. Mechanics of MEMS.
3. Dynamics of MEMS.
4. Fabrications processes for MEMS.
5. To Perform Multiphysics Analysis of a Thermal Actuator -I.
6. To Perform Multiphysics Analysis of a Thermal Actuator -II.
7. Design and Analysis of MEMS Pressure Sensor-I
8. Design and Analysis of MEMS Pressure Sensor-II
9. MEMS simulations using COMSOL
10. Nanotechnology basics

Major Equipment:

MEMS simulation software may be used for the performance of simulation.

List of Open Source Software/learning website:

The website of NPTEL may be utilized for additional learning.