

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS (47)

FUNDAMENTALS OF MICRO MECHATRONICS SYSTEMS

SUBJECT CODE: 2724703

M.E. 2ND SEMESTER

Type of course: Engineering Science

Prerequisite: NA

Rationale: This subject deals with fundamentals of Microelectromechanical Systems and its applications, which are useful for Mechatronics engineers.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks	
L	T	P		Theory Marks		Practical Marks					
			ESE (E)	PA (M)	ESE (V)		PA (I)				
					ESE	OEP	PA	RP			
3	2#	2	5	70	30	20	10	10	10	10	150

Sr. No	Contents	Teaching Hrs	Weightage (%)
1	Introduction to MEMS and Micro Systems: Microsystems and Microelectronics – Miniaturization – Micro sensors: Chemical Sensors- Optical Sensors- Pressure Sensors- Thermal Sensors – Micro actuators and Micro motors.	10	25
2	Microsystem Materials: Molecular Theory and Intermolecular Forces – Silicon Piezo Resistors– Electrochemistry – Substrates and Wafers – Silicon Compounds – Polymers – Packaging Materials.	08	20
3	Microsystem Fabrication Process: Photolithography – Ion Implantation – Diffusion –Oxidation – Chemical Vapor Deposition – Etching – Applications of MEMS in Automatic-Telecom and Other Industries.	06	15
4	Introductory concepts in modeling: Theory of elasticity, Solution Procedures in linear theory of elasticity, Theory of laminated composites, Micromechanical analysis of a laminae, wave propagation in structures	06	15
5	Modeling of Smart sensors and Actuators: Introduction, Constitutive modeling, Finite Element modeling, Modeling of magnetostrictive sensors and actuators, Modeling of Micro Electro Mechanical systems, Active Control Techniques	10	25
TOTAL		40	100

Reference Books:

1. Tai, Ran Hsu, "MEMS & Microsystems Design & Manufacture", Tata Mc Graw Hill, 2002.
2. Smart Materials Systems and MEMS: Design and Development Methodologies, Vijay K Varadan, K.J. Vinoy and S. Gopalakrishnan, John Wiley and sons.
3. The MEMS Hand book, Mohamed Gad-el-Hak, CRC Press, New York, London.

Course Outcomes:

After learning the course the students should be able to

1. Attain a broad range of the knowledge required to flourish in the rapidly developing field of MEMS and Nanotechnology.
2. Facilitate the application of basic physical laws, chemical laws, dynamic behaviour as well as steady state performance to design and synthesize MEMS and Microsystems.
3. Acquaint him / her with applications of MEMS fabrication techniques to solve the problems encountered at a macro level.
4. Gain Proficiency in modeling, simulating and evaluating MEMS and Microsystems..

List of Practicals

1. To Perform Static Analysis of a Corner Bracket.
2. To Perform Interference Fit and Pin Pull-Out Contact Analysis.
3. To Perform Modal Analysis of a Model Airplane Wing.
4. To Perform Multiphysics Analysis of a Thermal Actuator -I.
5. To Perform Multiphysics Analysis of a Thermal Actuator -II.
6. Tutorial – 6 Introduction to MEMS & Microsystems.
7. Tutorial – 7 Mechanics of MEMS.
8. Tutorial – 8 Dynamics of MEMS.
9. Tutorial – 9 Fabrications processes for MEMS.
10. Design and Analysis of MEMS Pressure Sensor-I
11. Design and Analysis of MEMS Pressure Sensor-II
12. Design and Analysis of MEMS Pressure Sensor-III

Tutorials:

Tutorial classes may be arranged as per the requirements of the subject.

Design based/open ended problem

Student may be given a task to exhibit the knowledge of the course studied during the academic year.

Major Equipment:

ANSYS -14.5 - Software

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.