GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Biomedical Engineering (03)
SUBJECT NAME: BIOMEDICAL MICROSYSTEMS
SUBJECT CODE: 2170311
B.E. 7th SEMESTER

Type of course: Department Elective

Prerequisite: Basic Physics, Mechanics, Basic principles of different sensors, Basics of Material science.

Rationale:
To impart in students detailed knowledge about Principle and working of Micro electro mechanical system (MEMS),
To give brief knowledge about Fabrication process of MEMS.
To give brief knowledge about applications of Bio Microelectromechanical System (Bio-MEMS) technology for therapeutic, diagnosis etc.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	30	0	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning.

Content:

Sr. No.	Content	Total Hrs	%
1	**Introduction to Microelectromechanical (MEMS) Technology:** Historical perspective, Development of MEMS Technology, MEMS Technology: Present, Future and Challenges MEMS Applications Comparison of MEMS and Microelectronics	8	20
2	**Fabrication Processes:** Different Materials, Substrates, Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD), Etching Processes, Patterning, Wafer Bonding, Annealing, Chemical Mechanical Polishing (CMP), Material Doping.	8	20
3	**MEMS Technologies:** Bulk Micromachining, LIGA (Lithographie, Galvanoformung, Abformung), Sacrificial Surface Micromachining,	8	15

4	**MEMS Sensors and Actuators**: MEMS Actuators, MEMS Sensing, Electron Tunneling, Sensor Noise, MEMS Physical Sensors, Chemical Sensors.	7	10
5	**MICRO/NANO BIOSENSORS:** Classification of physical sensors, Integrated, Intelligent or Smart sensors, Bio sensing Principles and sensing methods, Biosensors arrays and Implantable devices.	7	15
6	**Introduction to different Biomedical Applications of Microsystems:** Delivery of Diagnostic and Therapeutic Agents to Vascular Targets, Real-Time Biological Imaging and Detection, Diagnostic and Therapeutic Applications of Metal Nano shells, Micro devices for Oral Drug Delivery etc.	8	20
	Total	46	100

Text Books:

1. Senturia, Stephen, D., "Microsystem Design", Kluwer Academic Publishers, 2001
2. Microelectromechanical system design, James j. allen. Taylor & Francis 2nd edition.
3. BioMEMS and Biomedical Nanotechnology, volume III Tejal desai, sangetha Bhatia.
4. Biomedical Nanotechnology. Neelina H Malsch , Taylor & Francis

References:

1. Manz, A., & Becker, H.(Eds.), "Microsystem Technology in Chemistry and Life Sciences",
2. Springer-Verlag, New York, 1999. ISBN: 3-540-65555-7.
3. Bao, M., H., "Micromechanical Transducers: Pressure sensors, accelerometers, and
4. gyroscopes", Elsevier Publications, New York, 2000.
5. Lambrechts, M., "Biosensors: Microelectrochemical Devices", CRC Press, 1992.
6. Buerk, Donald, G., "Biosensors: Theory and Applications", CRC Press, 1995.
7. Madon, Marc, "Fundamentals of Micro fabrication", CRC Press, 1997.
8. Kovacs, Gregory, "Micro machined Transducers Sourcebook", WCB McGraw-Hill, Boston, 1998.
9. Saliterman Steven, S., "Fundamentals of BioMEMS and Medical Microdevices", Wiley
10. Interscience, SPIE Press Monograph Vol. PM153.

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	**U Level**	**A Level**	**N Level**	**E Level**
25%	**30%**	**25%**	**10%**	**10%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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.

Course Outcome:

After learning the course the students should be able to:
1. Understand the MEMS Technology and its biomedical application.
2. Learn the Fabrication process of Micro electro mechanical systems.
3. Learn MEMS Sensors and Actuators, biosensors, smart sensors
4. Understand different challenges to design Biomedical Microsystems.
5. Understand the various applications for curing different diseases accurately by using BioMEMS Technology.

List of Experiments: (Outlines)
1. Introduction to MEMS Technology.
2. To study different Fabrication processes of MEMS.
3. To study different MEMS Technologies.
4. To study various types of MEMS Sensors and Actuators.
5. To study various types of Micro/Nano Biosensors.
6. To study the application of Vascular Zip Codes and Nanoparticle Targeting.
7. To study the application of Real-Time Biological Imaging and Detection.
8. To study the application of Diagnostic and Therapeutic Applications of Metal Nano shells.
9. To study the application of Micro devices for Oral Drug Delivery.

Active Learning Assignments: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will assign topics from which students can grasp knowledge about current scenario of the Medical Optics. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.