Lecture 01

MEMS Syllabus, CO and PO

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MEMS Syllabus

MEMS - Credits, Examination Scheme and Course Prerequisite

Subject Code	Course Name	Teaching Scheme	Credits Assigned					
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
EXC803	MEMS Technology	04	--	--	04		--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC803	MEMS Technology	20	20	20	80	-	-	-	100

Course Pre –requisite:

- EXC 404: Basic VLSI Design
- EXC 604: IC Technology

MEMS - Syllabus

Module No.	Unit No.	Topics	Hrs.
1.		**Introduction to MEMS**	04
	1.1	Introduction to MEMS & Real world Sensor/Actuator examples (DMD, Air-bag, pressure sensors). MEMS Sensors in Internet of Things (IoT), BioMedical Applications	
2		**MEMS Materials and Their Properties**	10
	2.1	Materials (eg. Si, SiO2, SiN, Cr, Au, Ti, SU8, PMMA, Pt); Important properties: Young modulus, Poisson's ratio, density, piezoresistive coefficients, TCR, Thermal Conductivity, Material Structure. Understanding Selection of materials based on applications.	
3		**MEMS Fab Processes – 1**	11
	3.1	Understanding MEMS Processes & Process parameters for: Cleaning, Growth & Deposition, Ion Implantation & Diffusion, Annealing, Lithography. Understanding selection of Fab processes based on Applications	
4		**MEMS Fab Processes – 2**	10
	4.1	Understanding MEMS Processes & Process parameters for: Wet & Dry etching, Bulk & Surface Micromachining, Die, Wire & Wafer Bonding, Dicing, Packaging. Understanding selection of Fab processes based on Applications	
5		**MEMS Devices**	11
	5.1	Architecture, working and basic quantitative behaviour of Cantilevers, Microheaters, Accelerometers, Pressure Sensors, Micromirrors in DMD, Inkjet printer-head. Understanding steps involved in Fabricating above devices	
6		**MEMS Device Characterization**	06
	6.1	Piezoresistance, TCR, Stiffness, Adhesion, Vibration, Resonant frequency, & importance of these measurements in studying device behavior, MEMS Reliability	
		Total	**52**

MEMS - Recommended Books

Recommended Books:

1. An Introduction to Microelectromechanical Systems Engineering; 2nd Ed - by N. Maluf, K Williams; Publisher: Artech House Inc
2. Practical MEMS - by Ville Kaajakari; Publisher: Small Gear Publishing
3. Microsystem Design - by S. Senturia; Publisher: Springer
4. Analysis and Design Principles of MEMS Devices - Minhang Bao; Publisher: Elsevier Science
5. Fundamentals of Microfabrication - by M. Madou; Publisher: CRC Press; 2 edition
6. Micro Electro Mechanical System Design - by J. Allen; Publisher: CRC Press
7. Micromachined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill

MEMS - Examination Scheme

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Objectives

MEMS - Course Objectives

Course Objective:

- To provide a basic knowledge of MEMS processing steps and processing modules.
- To demonstrate the use of semiconductor based processing modules used in the fabrication of variety of sensors and actuators (e.g. pressure sensors, accelerometers, etc.) at the micro-scale.
- To provide an understanding of basic design and operation of MEMS sensors and transducers.

Program Outcome

MEMS - Program Outcome

Program Outcome	Description
Pa	an ability to apply knowledge of mathematics, science, and engineering principles
Pb	an ability to apply this knowledge of mathematics, science, and engineering principles to identify, formulate, and solve engineering problems,
Pc	an ability to design and conduct experiments, as well as to analyze and interpret data,
Pd	an ability to exhibit management principles and to function as a member of multidisciplinary teams
Pe	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic,environmental, social, political, ethical, health and safety, manufacturability, and sustainability,
Pf	a recognition of the need for
Pg	a knowledge of contemporary issues
Ph	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice,
Pi	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context,
Pj	an understanding of professional and ethical responsibility,
Pk	an ability to communicate effectively, and
Pl	an ability to understand and expertise in various high-end and advanced computational and simulation software like MATLAB, Labview, Xilinx, Microwind, Qualnet etc.