318EDE01 **MICRO ELECTRO MECHANICAL SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To know about the basic concept of MEMS and microsystems.
- To learn about various material and fabrication process used in MEMS.
- To judge about the mechanics involved in microsystems.
- To know about various manufacturing methods and packing techniques.
- To familiar with microsystem design and application of MEMS in industry.

UNIT I INTRODUCTION **9**

Overview, Microsystems and microelectronics, Working principle of Microsystems, micro actuation techniques-micro sensors-types, microactuators-types, micropump- micromotors-micro-valves-microgrippers, scaling laws-scaling in geomentry, scaling in rigid body dynamics, scaling in electrostatic forces, scaling in electricity, scaling in fluid mechanics, scaling in heat transfer.

UNIT II MATERIALS AND FABRICATION PROCESS **9**

Substrates and wafer-single crystal silicon wafer formation, ideal substrates - mechanical properties, silicon compounds - Sio_2, SiC, Si_3N_4 and polycrystalline silicon, Silicon piezoresistors - Gallium arsenide, Quartz-piezoelectric crystals, polymers for MEMS -conductive polymers, Photolithography, Ion implantation, Diffusion, Oxidation, CVD, Physical vapor deposition, Deposition by epitaxy, etching process.

UNIT III MICROMECHANICS **9**

Introduction-static bending of thin plates-circular plates with edge fixed, rectangular plate with all edges fixed and square plate with all edges fixed, Mechanical vibration-resonant vibration, micro accelerometers-design theory and damping coefficients, thermo mechanics, thermal stresses, fracture mechanics, stress intensity factors, fracture toughness and interfacial fracture mechanics.

UNIT IV MICRO SYSTEM MANUFACTURING AND PACKAGING **9**

Clean room technology, Bulk Micro manufacturing- surface micro machining –LIGA-SLIGA-Micro system packaging-materials-die level-device level-system, level-packaging techniques-die preparation, surface bonding, wire bonding, sealing.

UNIT V MICRO SYSTEM DESIGN **9**

Design considerations-process design, mask layout design, mechanical design-applications of micro system in automotive industry, bio medical, aero space-telecommunications.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Have basic foundation education in MEMS.
CO2: Become familiar with micro fabrication techniques.
CO3: Become fluent with design, analysis and testing of MEMS.
CO4: Select the most suitable manufacturing process and strategies for micro fabrication.
CO5: Assess whether using a MEMS based solution is relevant and best approach.

TEXT BOOKS

1. Chang Liu, “Foundation of MEMS”, Pearson Edition, 2012.
2. Nitaigour Premchand Mahalik, “MEMS”, Tata McGraw Hill Companies, 2009.

REFERENCE BOOKS

1. James J Allen, Dekker, “Mechanical Engineering”, CRC Press, 2005.
2. Marc F Madou, “Fundamentals of Micro Fabrication”, CRC Press, 2002.
3. Mohamed Gad-el-Hak, “The MEMS Hand book”, CRC press, 2002.
4. Francis E.H Tay and W.O Choong, “Microfludics and BioMEMS Applications”, Springer, 2002.
5. Julian W. Gardner, Vijay K.Varadan, Osama O.Awadel Karim, “Microsensors MEMS and Smart Devices”, John Wiley & sons Ltd., 2001.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Have basic foundation education in MEMS.	3	3		2		1			2			1	2		1
Co2	Become familiar with micro fabrication techniques.	2	2										1		3	
Co3	Become fluent with design, analysis and testing of MEMS.	2	1		3		1			2					3	
Co4	Select the most suitable manufacturing process and strategies for micro fabrication.	3	3											2		1
Co5	Assess whether using a MEMS based solution is relevant and best approach.	2	3		2		2			2					1	

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318EDE03 **PRODUCT LIFE CYCLE MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To know about the importance of product life cycle.
- To know the concept of product development process and to study the methodology of product design.
- To gain knowledge on product modeling and know the types of analysis tools.
- To implement the PDM technology for industries.
- To develop advanced knowledge based product and processes models.

UNIT I INTRODUCTION AND PRODUCT LIFE CYCLE ENVIRONMENT 9

Background, Overview, Need, Benefits, Concept of Product Life Cycle. Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement.

Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, Change Management for PLM.

UNIT II PRODUCT DEVELOPMENT PROCESS & METHODOLOGIES 9

Integrated Product development process - Conceive – Specification, Concept design, Design - Detailed design, Validation and analysis (simulation), Tool design, Realize – Plan manufacturing, Manufacture, Build/Assemble, Test (quality check), Service - Sell and Deliver, Use, Maintain and Support, Dispose. Bottom-up design, Top-down design, Front loading design workflow, Design in context, Modular design. Concurrent engineering - work structuring and team Deployment - Product and process systemization - problem, identification and solving methodologies. Product Reliability, Mortality Curve. Design for Manufacturing, Design for Assembly. Design for Six Sigma.

UNIT III PRODUCT MODELLING AND TYPES OF ANALYSIS TOOLS 9

Product Modeling - Definition of concepts - Fundamental issues - Role of Process chains and product models -Types of product models - model standardization efforts-types of process chains - Industrial demands.

Design for manufacturing - machining - casting and metal forming - optimum design - Design for assembly and disassembly - probabilistic design concepts - FMEA - QFD - Taguchi Method for design of experiments -Design for product life cycle. Estimation of Manufacturing costs, Reducing the component costs and assembly costs, Minimize system complexity.

UNIT IV PRODUCT DATA MANAGEMENT (PDM) TECHNOLOGY 9

Product Data Management – An Introduction to Concepts, Benefits and Terminology, CIM Data. PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition and implementation.

UNIT V RECENT ADVANCES 9

Intelligent Information Systems - Knowledge based product and process models - Applications of soft computing in product development process - Advanced database design for integrated manufacturing.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Compare product data, information, structures and PLM concepts.

CO2: Apply PLM systems in organization verticals including production, after sales, sales and marketing, and subcontracting.

CO3: Measure benefits of PLM implementation in daily operations, material costs, productivity of labor and quality costs.

CO4: Apply PLM concepts for service industry and E-Business.

CO5: Know about the applications of soft corrupting.

TEXT BOOKS

1. Grieves, Michael. "Product Lifecycle Management", McGraw-Hill, 2006.
2. Antti Saaksvuori, Anselmi Immonen, "Product Life Cycle Management", Springer, 2nd Edition, 2013.

REFERENCE BOOKS

1. Stark, John. "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 3rd Edition, 2015.
2. Karl T Ulrich and Steven D. Eppinger, "Product Design & Development", McGraw Hill International Edns, 2008.
3. Burden, Rodger, "PDM: Product Data Management", Resource Pub, 2003.
4. Crnkovic, Ivica; Asklund, Ulf & Dahlqvist, Annita Persson. "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003.
5. Clement, Jerry; Coldrick, Andy; & Sari, John, "Manufacturing Data Structures", John Wiley & Sons, 1995.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Compare product data, information, structures and PLM concepts.	1		2	1	2	1							1		
Co2	Apply PLM systems in organization verticals including production, after sales, sales and marketing, and subcontracting.		1		1											1
Co3	Measure benefits of PLM implementation in daily operations, material costs, productivity of labor and quality costs.			1										1		2
Co4	Apply PLM concepts for service industry and E-Business.		1			1								1		1
Co5	Know about the applications of soft corrupting.	1				2										1

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318EDP01 **PROJECT WORK (PHASE – I)**

L	T	P	C
0	0	8	4

COURSE OBJECTIVES:

- To strengthens the students to carry out the project on their own and to implement their innovative ideas.
- To deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation or an analysis.
- To use their engineering education and communication skills for success in life.
- To involve in management or entrepreneurship, including transitioning technologies to the world.
- To develop new knowledge and products that will promote sustainable economic and environmental developments to improve the quality of life.

GUIDELINES

1. The project work is to enable the individual student to work on a project involving theoretical and experimental studies related to the branch of study.
2. Every project work shall have a guide who is the member of the faculty of the institution.
3. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement and methodology. The final report shall be typewritten form as specified in the guidelines.

EVALUATION

1. The progress of the project is evaluated by a review committee consisting of a minimum of three members.
2. The review committee may be constituted by the Head of the Department.
3. The continuous assessment shall be made by conducting three reviews.
4. Final review will be done by the committee that consists of minimum of three members one of which should be the guide. (If possible include one external expert examiner within the college)

TOTAL HOURS:150 PERIODS

COURSE OUTCOMES

The students will have

CO1: Clear idea of their area of project work.

CO2: The knowledge to carryout the phase II work in systematic way.

CO3: Ability to compile relevant data, interpret & analyze it and test the hypotheses wherever applicable.

CO4: Ability to plan a research design including the sampling, observational, statistical and operational designs keeping in mind the ethical aspects of research.

CO5: Ability to arrive at logical conclusions and propose suitable recommendations on the research problem.

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Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Clear idea of their area of project work.	1	1	1		1	1			1	1		1	1		1
Co2	The knowledge to carryout the phase II work in systematic way.	1		1		1	1						1	1		1
Co3	Ability to compile relevant data, interpret & analyze it and test the hypotheses wherever applicable.															1
Co4	Ability to plan a research design including the sampling, observational, statistical and operational designs keeping in mind the ethical aspects of research.	2	1			2								2		1
Co5	Ability to arrive at logical conclusions and propose suitable recommendations on the research problem.					1							1	1		1

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318EDP02	INTERNSHIP	L	T	P	C
		0	0	6	3

COURSE OBJECTIVES:

- To make the students to get practical exposure and learn about various activities happening in the industries.
- To make the students to learn about effective communication, presentation skills and report preparation.
- To prepare the students with key knowledge and skills in applied design, analysis, manufacture, test, and assembly of mechanical systems.
- To prepare the students who can communicate effectively and who can contribute as members of a team.
- To prepare the students with a broad knowledge of mechanical engineering technology practices applicable to many different industry types.

GUIDELINES

1. It is mandatory that each student should undergo internship / in-plant training in reputed industries for the duration of 2-3 weeks after second semester end examination. Then the student has to submit a hard copy of the training report not less than 10 pages. Also he / she has to give presentation on the training report for about 30 minutes.
2. Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

EVALUATION

1. The training report will be evaluated by the faculty in-charge.
2. There is internal assessment and end examination.

TOTAL HOURS:30 PERIODS

COURSE OUTCOMES

The student will have

CO1: Practical knowledge about various activities like processes, design, quality control, etc that are taking place in industries.

CO2: The skills about effective communication, presentation and report preparation.

CO3: Gain more experience in accomplishing a long-term project, and managing the progress throughout the year.

CO4: Gain more experience in working in a professional team, with colleagues who have different views, talents, and backgrounds.

CO5: Gain more experience at identifying the necessary technical and non-technical methods needed to solve an industrial problem.

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Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Practical knowledge about various activities like processes, design, quality control, etc that are taking place in industries.		2		1								1	1		1
Co2	The skills about effective communication, presentation and report preparation.	2	1		1									1		2
Co3	Gain more experience in accomplishing a long-term project, and managing the progress throughout the year.	2	2		2									1		3
Co4	Gain more experience in working in a professional team, with colleagues who have different views, talents, and backgrounds.		1		2									2		2
Co5	Gain more experience at identifying the necessary technical and non-technical methods needed to solve an industrial problem.	1			1						1		1	2		1

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418EDP01	PROJECT WORK (PHASE – II)	L	T	P	C
		0	0	30	15

COURSE OBJECTIVES:

The objectives of the project are

- To get an opportunity to synthesize knowledge from various areas of learning, and critically and creatively apply it to real life situations.
- To acquire skills like collaboration, communication and independent learning, prepares them for lifelong learning and the challenges ahead.
- To deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation or an analysis.
- To use the engineering technical skills and modern engineering tools necessary for practical applications.
- To document and present one's own research work, with strict requirements on structure, format, and language usage for publication.

GUIDELINES

1. The project work is to enable the individual student on a project involving theoretical and experimental studies related to the branch of study.
2. Every project work shall have a guide who is the member of the faculty of the institution.
3. They should publish the papers in the journals / conferences.
4. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. The final report shall be typewritten form as specified in the guidelines.

EVALUATION

1. The progress of the project is evaluated by a review committee consisting of a minimum of three members.
2. The review committee may be constituted by the Head of the Department.
3. The continuous assessment shall be made by conducting three reviews.
4. Final review will be done by the committee that consists of minimum of three members one of which should be the guide. (If possible include one external expert examiner within the college)

TOTAL HOURS:90 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Use the engineering technical skills and modern engineering tools necessary for practical applications.

CO2: Use design principles and develop conceptual, engineering design and fabrication of various components.

CO3: Take up any challenging practical problems and find solution by formulating proper methodology by attending different conferences.

CO4: Create the document for research article with correct format and structure.

CO5: Gain Practical knowledge about various activities like processes, design, quality control that are taking place in industries.

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Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Use the engineering technical skills and modern engineering tools necessary for practical applications.	1	1		1	1					1			1		1
Co2	Use design principles and develop conceptual, engineering design and fabrication of various components.	1	1	2		1					1			2		2
Co3	Take up any challenging practical problems and find solution by formulating proper methodology by attending different conferences.	1	1	1										1		1
Co4	Create the document for research article with correct format and structure.	1				1					2			1		
Co5	Gain Practical knowledge about various activities like processes, design, quality control that are taking place in industries.	1	1	1	1	1						1		1		

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