The LNMIIT, Jaipur Department of Mechanical-Mechatronics Engineering	LNMIIT The LNM Institute of Information Technology

Subject Code: **MME-3062**	Course Title: **Smart Materials for Instrumentation**	Total Contact Hours: **40**	**L: 3**	**T: 0**	**P: 0**	**C: 3**
Pre-requisite:		Year: 3	Semester: **Even**			
Type of Course**: Other Elective (OE)**						

***** L – Lectures, T – Tutorials, P – Practical C – Credit***

Learning Objective:

This course is designed as an elective course for undergraduate students of engineering who are in their 3rd year. The content of this course covers basics of different smart materials, their potential use in development of instrumentation. This course is also useful in helping students to learn the use of smart materials to automate the different tasks at micro/nano level workspace and to develop micro/nano mechatronics system.

Course outcomes (COs):

On completion of this course, the students will have the ability to:		**Bloom's level**
CO1	**Recognize and Understand** the fundamental concepts of smart materials and smart materials based MEMS. Creation of Smart MEMS applications.	**2**
CO2	**Understand** and **Analyze** the behavior of piezoelectric materials and their response.	**4**
CO3	**Understand** and **Analyze** the behavior of piezoresistive materials and their response.	**4**
CO4	**Understand** and **Analyze** the behavior of magneto-strictive materials and their response.	**4**
CO5	**Understand** and **Analyze** the behavior of shape memory alloy and their response.	**4**
CO6	**Understand** and **Analyze** the behavior of Active Smart Polymers inclusive of electroactive polymers and their response.	**4**

Course Topics:

Topics	**Lecture Hours**	**CO**
UNIT - I **Introduction:** Smart Materials definition and applications, smart systems using smart materials, actuators **Smart Materials based MEMS:** Electrodes Configuration, Design Issues, Pyroelectricity, Intelligent MEMS devices based on Smart Materials **Smart MEMS Applications:** Sensors developed, MEMS device for motion and accelerometers, MEMS Application, Crystal Growth Processes, MEMS Development, Processing Techniques	10	CO1,
Unit – II **Piezoelectric Material:** History of piezoelectricity, materials for Piezoelectric effect, Development of Piezoelectric Devices,	06	CO2

Piezoelectric Actuator, Bimorph, Piezostacks, Modeling of the Piezoelectric Devices		
Unit - III **Piezoresistive Material:** Piezoresistivity, Applications of Piezoresistive Devices, Design, modeling and development of Piezoresistive Devices	06	CO-3
Unit - V **Magnetostrictive Polymer:** Magnetostrictive Principle, Magnetostrictive Materials and their history, Different Magnetostrictive effects, Applications of Magnetostrictive Material	06	CO4
Unit - V **Shape Memory Alloys:** Shape Memory Effect (SME), Alloys with SME, One-Way SME, Pseudoelasticity, Two-way SME, Application of SMA	06	CO5
Unit - V **Active Smart Polymer:** Active Smart Polymers, Classification of Electro-active Polymers, Design and development of Electro-active polymeric devices, Applications	06	CO6

Textbook References:

Text Book:

1. Inderjit Chopra and Jayant Sirohi, *Smart Structures Theory, Cambridge Press*
2. V.K. Varadan, K.J. Vinay, and S. Gopalakrishnan, *Smart Materials Systems and MEMS Design and Development Methodologies, John Wiley and Sons*

Reference books:

1. Ralph C. Smith, *Smart Material Systems: Model Development, Frontier in Applied Mathematics* .

Additional Resources:

NPTEL, MIT Video Lectures, Web resources etc.

Evaluation Method		
Item	**Marks**	
Assignment cum Quiz	30	CO1, CO2, CO3, CO4, CO5, CO6
Midsem	30	CO2, CO3, CO4
EndSem	40	CO1, CO2, CO3, CO4, CO5, CO6

CO and PO Correlation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	-	-	-	-	-	-	2			
CO2	3	3	3	2	3	-	-	-	-	-	-	2			
CO3	3	3	3	2	3	-	-	-	-	-	-	2			
CO4	3	3	3	2	2	-	-	-	-	-	-	2			

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Approved By: