22MEHO208	SMART MATERIALS AND STRUCTURES				
PREREQUISITES		CATEGORY	L	T	P	C
		PE	3	0	0	3

COURSE OBJECTIVES:

1. Knowledge of smart materials and structures is essential designing mechanical systems for advanced engineering applications, the course aims at training students in smart materials and structures application and analysis

UNIT I	SMART STRUCTURES	9	0	0	9

Types of Smart Structures, Potential Feasibility of Smart Structures, Key Elements of Smart Structures, Applications of Smart Structures. Piezoelectric materials, Properties, piezoelectric Constitutive Relations, Depoling and Coersive Field, field strain relation. Hysteresis, Creep and Strain Rate effects, Inchworm Linear Motor. Beam Modeling: Beam Modeling with induced strain Rate effects, Inchworm Linear Motor Beam Modeling with induced strain Actuation-single Actuators, dual Actuators, Pure Extension, Pure Bending harmonic excitation, Bernoulli-Euler beam Model, problems, Piezoelectrical Applications.

UNIT II	SHAPE MEMORY ALLOY	9	0	0	9

Experimental Phenomenology, Shape Memory Effect, Phase Transformation, Tanaka's Constitutive Model, testing of SMA Wires, Vibration Control through SMA, Multiplexing. Applications Of SMA and Problems. ER and MR Fluids: Mechanisms and properties, Fluid Composition and behavior, The Bingham Plastic and Related Models, Pre-Yield Response. Post-Yield flow applications in Clatches, Dampers and Others.

UNIT III	VIBRATION ABSORBERS	9	0	0	9

series and Parallel Damped Vibrations (OverView), Active Vibration Absorbers, Fiber Optics, Physical Phenomena, Characteristics, Sensors, Fiber Optics in Crack Detection, applications. Control of Structures: Modeling, Control Strategies and Limitations, Active Structures in Practice. 13Hours

UNIT IV	MEMS	9	0	0	9

Mechanical Properties of MEMS Materials, Scaling of Mechanical Systems, Fundamentals of Theory, The Intrinsic Characteristics of MEMS, Miniaturization, Microelectronics Integration.

UNIT V	DEVICES	9	0	0	9

Sensors and Actuators, Conductivity of Semiconductors, Crystal Planes and Orientation, (Stress and Strain Relations, Flexural Beam Bending Analysis Under Simple Loading Conditions), Polymers in MEMS, Optical MEMS Applications.

TOTAL(45L) : 45 PERIODS

TEXT BOOKS:

1. Smart Materials and Structures - M. V. Gandhi and B. So Thompson, Chapman and Hall, London; New York, 1992 (ISBN: 0412370107).
2. Smart Structures and Materials - B. Culshaw, Artech House, Boston, 1996 (ISBN :0890066817). 3. Smart Structures: Analysis and Design - A. V. Srinivasan, Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267).

REFERENCES:

1. Electro ceramics: Materials, Properties and Applications - A. J. Moulson and J. M. Herbert. John Wiley & Sons, ISBN: 0471497429
2. Piezoelectric Sensories : Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers, Springer, Berlin; New York, 2002 (ISBN: 3540422595).

3.	Piezoelectric Actuators and Wtrasonic Motors - K. Uchino, Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114).
4.	Handbook of Giant Magnetostrictive Materials - G. Engdahl, Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X).
5.	Shape Memory Materials - K. Otsuka and C. M. Wayman, Cambridge University Press, Cambridge; New York, 199~ (ISBN: 052144487X).

COURSE OUTCOMES: Upon completion of this course, the students will be able to:	Bloom Taxonomy Mapped
CO1	Understand the behavior and applicability of various smart materials	Understand
CO2	Design simple models for smart structures & materials	Create
CO3	Perform simulations of smart structures & materials application	Analyse
CO4	Conduct experiments to verify the predictions	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	0	0	0	0	0	0	0	2	2	0
CO2	2	2	1	1	2	0	0	0	0	0	0	0	2	2	0
CO3	2	2	1	1	2	0	0	0	0	0	0	0	2	2	0
CO4	2	2	1	1	2	0	0	0	0	0	0	0	2	2	0
Avg	2	2	1	1	2	0	0	0	0	0	0	0	2	2	0
3/2/1 – indicates strength of correlation (3 – high, 2- medium, 1- low)															