[Course Code]: Smart Materials for Instrumentation

Programme: B.Tech. Year: 4th Semester: VI
Course: Other Elective Credits: 3 Hours: 40

Course Context and Overview:

This course is designed as an elective course for undergraduate students of engineering who are in their 4th 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.

Prerequisites Courses:

Basics of Electronics, Automation, and measurement techniques.

Course outcomes (COs):

On completion of this course, students will be able to:

CO1	Different smart materials
CO2	Use of smart materials in automation
CO3	Development of micro/nano mechatronics Devices
CO4	Task handling using micro/nano mechatronics Devices

Text Books:

[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.

Course Module:

Units	Course Topics	Hours
Unit 1	**Introduction**	**4**
	Smart Materials definition and applications, smart systems using smart materials, actuators	
Unit 2	**Piezoelectric Material**	**6**
	History of piezoelectricity, materials for Piezoelectric effect, Development of Piezoelectric Devices, Piezoelectric Actuator, Bimorph, Piezostacks, Modeling of the Piezoelectric Devices	
Unit 3	**Piezoresistive Material**	**4**
	Piezoresistivity, Applications of Piezoresistive Devices, Design, modeling and development of Piezoresistive Devices	
Unit 4	**Magnetostrictive Material**	**6**
	Magnetostrictive Principle, Magnetostrictive Materials and their history, Different Magnetostrictive effects, Applications of Magnetostrictive Material	
Unit 5	**Active Smart Polymer**	**6**
	Active Smart Polymers, Classification of Electro-active Polymers, Design and development of Electro-active polymeric devices, Applications	
Unit 6	**Shape Memory Alloys**	**4**
	Shape Memory Effect (SME), Alloys with SME, One-Way SME, Pseudoelasticity, Two-way SME, Application of SMA	
Unit 7	**Smart Materials based MEMS**	**4**
	Electrodes Configuration, Design Issues, Pyroelectricity, Intelligent MEMS devices based on Smart Materials	
Unit 8	**Smart MEMS Applications**	**6**
	Sensors developed, MEMS device for motion and accelerometers, MEMS Application, Crystal Growth Processes, MEMS Development, Processing Techniques	

Evaluation Methods:

Item	Weightage (%)
Mid term	20
End term	50
Teacher's assessment (Assignment/Quiz etc.)	30

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