ME771A: Smart Materials and Structures (3-0-0-9)

CONCISE SYLLABUS

Overview of smart materials, Piezoelectric Ceramics, Piezo-polymers, Magnetostrictive Materials, Electroactive Polymers, Shape Memory Alloys, Electro and Magneto Rheological Fluids, Modelling of smart materials, introduction to composite smart materials, Mechanics of smart composite materials, Smart sensors based on high bandwidth low strain smart materials, Low-bandwidth high strain smart actuators, Micro-electro mechanical Smart Systems, Intelligent devices based on smart materials, Applications of Smart Actuators: Active and Hybrid Vibration Control, Active Shape Control, Distributed Sensing and Control of Smart Beams.

LECTURE WISE BREAK UP

OVERVIEW OF SMART MATERIALS


HIGH-BAND WIDTH, LOW STRAIN SMART SENSORS

Piezeoelectric Strain Sensors, In-plane and Out-of Plane Sensing, Shear Sensing, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Magnetostrictive Sensing, Villari Effect, Matteucci Effect and Nagoka-Honda Effect, Magnetic Delay Line Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM), System Identification using Smart Sensors

SMART ACTUATORS

Modelling Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magnetovolume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control

SMART COMPOSITES

Review of Composite Materials, Micro and Macro-mechanics, Modelling Laminated Composites based on Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, Governing Equation of Motion, Finite Element Modelling of Smart Composite Beams

ADVANCES IN SMART STRUCTURES & MATERIALS

References:

(a) Brian Culshaw, Smart Structures and Materials, Artech House, 2000
(b) Gauzenzi, P., Smart Structures, Wiley, 2009
(c) Cady, W. G., Piezoelectricity, Dover Publication