

ME 511 Advanced Materials and Processing (2-0-2-6)

Introduction of advanced materials and its manufacturing processes for engineering applications. Piezoelectric materials (PZT): piezoelectric effect, Dielectric hysteresis, piezoelectric constants, piezoelectric charge constants, dynamic behaviour of PZT transducers, piezoelectric materials and manufacturing techniques (stability, poling and depolarisation). Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Temperature assisted shape memory effect, Visco-elastic behaviour, magnetic shape memory effect. Various shape memory alloys. Manufacturing technology of SMAs. Electro rheological (ER) and magneto-rheological (MR) materials: Characteristics of ER and EM fluids. ER and EM materials. Composite materials: Design and manufacturing of polymer matrix, metal matrix and ceramic matrix composites. Various forms and type of reinforcements, fillers and additives. Design of composites for structural, wear resistance and high temperature applications. Micro-electro-mechanical (MEMS) systems. Introduction, characteristics of silicon wafers and other materials for MEMS applications. Various manufacturing techniques of MEMS components Materials for high temperature applications: Ni-Cr alloys, ODS materials, Ni base and Co based super alloys, carbon-carbon composites. Diffusion bond coating of high temperature materials. Powder metallurgy: Introduction and feature of powder metallurgy processes. Advanced solidification techniques: directional solidification, single crystal growth and levitation melting.

Texts/References:

- [1] Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman and Hall, 1992.
- [2] Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P, 1998
- [3] Taylor, W., Piezoelectricity, George Gordon and Breach Sc. Pub., 1985
- [4] Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing and Design. Marcel Dekker Inc, New York, 1993.