PMM321: ELECTRO CERAMICS

L	T	P	Cr
3	1	0	3.5

Course Objective(s): To understand basics of difference in metallic and ceramic structure; Influence of point defects on properties of ceramics. Different processing methods of electroceramics. Understanding of various functional electroceramics and their application.

Introduction: Structural differences in metals and ceramics, Rules of structure formation in Oxides/Ionic solids

Defects and Defect Chemistry: Role of defects in ionic conduction, Defects equilibrium, Diffusion through defects, Ionic and electronic conductivity for ceramics, Kröger–Vink notation, Arrhenius equation.

Ionic and Electronic Transport: Basic concepts of diffusion, Tracer diffusion, Self-diffusion, Chemical diffusion, Ambipolar diffusion, Ionic conduction in crystalline solid, Intrinsic and Extrinsic ionic conduction, Transference number, Nernst-Einstein relationship, and Conductivity-Diffusion relationship, Polaron theory, metal-ceramic interfaces and electronic transport into and through a dielectric material, Conduction mechanism in terms of Mott insulators, Semiconductors, Measurement techniques, Examples of ionic transport, in important applications.

Non-linear Dielectrics Polar and Nonpolar Ceramics: Crystal structure and Noncentrosymetricity, Tensor representation of properties, Piezoelectrics, Pyroelectrics, Ferroelectrics, Antiferroelectrics, Relaxors, Phenomenological theory (phase transitions) and soft mode theory, domain switching and domaindynamics., Measurement methods, Applications

Thermoelectric Oxides See-back and Peltier effect, Materials and applications

Magnetic Ferrites Ferrites structure and properties and their applications

Multiferroics and Magnetoelectrics: Principles, Classification, Magnetoelectric coupling, Materials, issues and possible applications.

Course Learning Outcomes (CLO):
Student will be able to:

1. Know the relationships between ceramic structure (electronic, microstructure and defect structure) and properties;
2. Learn how these variety of phenomena can be exploited in useful applications like fuel cells, sensors, and piezoelectric transducers;

Access current research in electronic, magnetic, and optical ceramics.

Recommended Books:

1. *Moulson A.J and Herbert, J.M., Electroceramics: Materials, Properties and Applications, Wiley (2003).*
2. *Hench L.L and West J.K, Principal of Electronic Ceramics, Wiley (1990).*
3. *Rahaman M.N, Ceramic Processing and Sintering, CRC, (2003).*
4. *Reed, J. Principles of Ceramics Processing, John Wiley & Sons, (1995).*
5. *Kingery W.D, Introduction to Ceramics, Wiley (1976).*