

Introduction to Electroceramics: Expected Course Schedule

This course is intended for engineers, technicians, and scientists with an interest in ceramics for electrical applications. Students aren't expected to know much about electrical ceramics coming in but shouldn't be scared of basic chemistry, concepts of thermodynamics, or simple circuits. The topics will be taught from an academic perspective but always with an eye towards industry relevance.

Topic details and emphasis will vary as the course proceeds based on the interests and backgrounds of participants, so the schedule below is simply a rough guide. Course materials will be provided (at least) the day before each class period. The books listed below are handy references but are not at all required (or expected) for this course.

<u>Class Period</u>	<u>Topics / Activities During Class</u>	<u>Assignments, Notes</u>
1) April 1, 2025	Intro/Overview; Materials of Interest; Nomenclature; Crystallography & Symmetry	Identify relevant crystal structures, systems, point groups
2) April 3, 2025	Applied Electric Fields; Conduction and Insulation; Basic Circuits; Application Examples	Identify and explain relevant operating fields / frequencies
3) April 8, 2025	Defects; Ceramic Processing Overview; Polarization Mechanisms; Frequency & Field	Identify relevant processing defects and boundary conditions that affect targeted properties
4) April 10, 2025	MLCCs and related (ML piezo, LTCC, ...)	Identify similar opportunities and associated challenges for scaling (doesn't have to be geometric)
5) April 15, 2025	Piezoelectricity and Ferroelectricity Basics; Tensor Notation	How does directionality matter in your product line(s), and is it being overlooked in some way?
6) April 17, 2025	Heckmann Diagrams; Pyroelectricity; Ferro and Piezo Applications	What underlying phenomena enable your product line(s)? Are boundary conditions appropriately reported/specified?
7) April 22, 2025	Relaxors; AFEs; Crystals and TGG	How do you balance processing cost (and complexity) vs. performance?
8) April 24, 2025	Varistors, PTCR, HTSC, and other fun examples	

Handy References:

1. Electroceramics: Materials, Properties, Applications, A.J. Moulson and J.M. Herbert (any edition); ISBN 978-8126553945
2. Physical Properties Of Crystals: Their Representation by Tensors and Matrices, J.F. Nye (any edition); ISBN 978-0198511656
3. Properties of Materials: Anisotropy, Symmetry, Structure, R.E. Newnham; ISBN 978-0198520764
4. Materials Engineering: Bonding, Structure, and Structure-Property Relationships, S. Trolier-McKinstry and R.E. Newnham; ISBN 978-1107103788
5. Piezoelectric Ceramics, B. Jaffe, W. Cook, and H. Jaffe; ISBN: 978-1878907103