



Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	PY601	Title of the Course	Composites, Bulk and Nanoceramics	L	T	P	C
Year	First	Semester	First	3	1	0	4
Pre-Requisite	M. Sc. with Physics	Co-requisite					
Course Objectives	To provide the students with basic knowledge of materials science, so that they would be able to understand and distinguish between the variety of materials based on their structure and properties.						

Course Outcomes	
CO1	To explain the description of a crystal structure in terms of atom positions, unit cells, and crystal symmetry.
CO2	To understand the electrical, thermal, and semiconducting properties of materials.
CO3	To understand the dielectric and magnetic properties of materials.
CO4	To develop an understanding of different materials like composites, ceramics, nanoceramics, and also their applications.
CO5	To introduce the synthesis and characterization techniques of materials.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Geometry of Crystals and Bonding	The Electronic Structure of Atoms, Atomic Bonding, Crystallography, Bravais Crystal System, Laws of Crystallography, Miller Indices, Geometrical Structure Factor, Determination of Crystal Structure, Crystal Structure Analysis, and Imperfections in Crystals.	8	CO1
2	Electrical, Thermal and Semiconducting Properties of Materials	Free Electron Theory Of Metals, Band Theory, Effective Mass, Fermi-Dirac Statistics, and Electron Distribution in Solids, Density of States and Fermi Energy, The Fermi Distribution Function, Electrical Conductivity From Quantum Mechanical Considerations, Factors Affecting Resistivity of Metals, Conductivity at High Frequency, Superconductivity, Semiconductors, classification of semiconductors, Fermi level, electrical charge neutrality, mobility, Energy Band Diagrams of Common Semiconductors, Hall Effect, Drift and Diffusion Current, Einstein's Relation, Continuity Equation, Diffusion Length.	8	CO2
3	Dielectric and Magnetic Properties of Materials	Polarization Mechanism, Types of Polarization, Behavior of Dielectric in Static Field, Behaviour of Dielectric in Alternating Field, Dielectric Loss and Strength, Ferroelectric Material, Piezoelectric, Smart Materials, Piezoelectricity, Langevin's Theory of Polarization in Polar Dielectrics. Classification of Magnetic Materials, Magnetic Anisotropy, Magnetostriction, Langevin's Theory of Diamagnetism and Paramagnetism, Weiss Theory of Ferromagnetism.	8	CO3
4	Composites, Ceramics, nanoceramics and Their Applications	Fibrous Composites, Matrix, Resin, Laminated Composite, Fiber-Reinforcement Composites, Metal Matrix Composite, Particulate Composite, Filled Composite, Sandwich Structures, Facing Material, Core Materials, Honeycomb Structure, Cladded Metal Structure, Structure of Ceramics, Silicate Structures, Powder Processing, Thermal Treatments, Thermal Properties of Ceramics, Mechanical Properties of Ceramics, Electrical Properties of Ceramics, Ferroelectric Ceramics, Classification of Ferroelectric Crystals (KDP, TGS, Perovskites Type), Barium Titanates and Modified Barium Titanates, Piezoelectric Ceramics, PZT (Lead Zirconate Titanate and PLZT System), Applications, Glasses, Glass Transition Temperature, Structure of Glass, Properties of Glass, Glass Forming.	8	CO4
5	Synthesis and Characterizations of nanomaterials	Ball Milling, Molecular beam epitaxy, Chemical vapor deposition, Ion sputtering, Electron deposition, Sol-gel technique, hydrothermal processing, Solid state reaction method. X-ray diffraction, Particle size determination, Scanning electron microscope (SEM), Transmission electron microscope (TEM), UV-VIS-IR spectrophotometers, Atomic force microscopy (AFM).	8	CO5

Reference Books:

- Ceramic and Glass Materials, Structure, Properties and Processing: James F. Shackelford, Robert H. Doremus, Springer.
- Ceramic Materials: Processes, Properties and Applications: Philippe Boch, Jean-Claude Niepce, HERMES Science Europe Ltd, 2001.
- Ceramic Matrix Composites: Fiber Reinforced Ceramics and their Applications: Walter Krenkel, WILEY-VCH Verlag GmbH & Co.
- Handbook of dielectric, piezoelectric and ferroelectric materials: Synthesis, properties and Applications, Zuo-Guang Ye, WOODHEAD PUBLISHING LIMITED, Cambridge England.
- Solid State Physics: C. Kittel
- Material Science and Engineering, William D. Callister.
- Introduction to Engineering Material, George Murray, Charles V. White, Wolfgang Weise.

e-Learning Source:

<https://www.digimat.in/nptel/courses/video/113108083/L27.html>
[NPTEL](#)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	1		1	2	3			1	1	3	1	1	2
CO2	2	2		2	3	3			1	3	3	3	1	2
CO3	3	1		2	2	3			1	3	3	3	2	2
CO4	2	3		3	3	3			2	3	3	3	3	3
CO5	3	2		3	3	3			3	3	3	1	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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