

FCYC-----902	Materials Chemistry	3-1-0	4 credits
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Module I

[10 Lectures]

Materials and their classification: Matter, materials science, broad classification of materials, - metal and alloys, polymers and elastomers, ceramics and refractories, semiconducting and electronic materials, super metal and super conductors, materials for nuclear technology and for aero-space technology, magnetic materials, dielectric materials, optical and opto-electronic materials, bio- medical materials, thermo- electrical materials, structural and construction engineering materials, special and nano materials, SMART materials.

Module II

[10 Lectures]

General Strategies for preparation and production of materials: Wet chemical processes, the sol-gel route, precursor synthesis, carbo-thermic and thermo- chemical treatments, hydrothermal, pyrochemical, metallurgical and chemical routes, heat treatment methods, surface deposition and film formation methods, special fabrication and processing techniques. Elementary ideas on basic properties of important materials (overview only): Mechanical properties and impact properties, brittle, malleable and ductile properties, crystalline, poly crystalline materials. Phase rule and phase diagram its applications. Overview of material characterization: x- ray diffraction for internal structure, electron-microscopy for surface property.

Module III

[10 Lectures]

Dielectric and Magnetic Materials: Dielectric materials: Electrical dipole moment, dielectrics, dielectric constants and polarization, microscopic displacement, temperature and frequency dependence of dielectric constant, dielectric break down. Synthetic strategies for preparation of dielectric materials. Ferro electrics. Piezoelectric. Pyroelectrics. Application of dielectric materials.

Magnetic materials: Concept/ origin of magnetism, diamagnetism, para magnetism, ferromagnetism, hysteresis- soft and hard magnets. Synthetic strategies. Ferrites, ortho-ferrites and plumba ferrites. Applications of magnetic material, magnetic bubbles.

Module IV

[10 Lectures]

Dielectric and Magnetic Materials:

Semiconductor and electronic materials: Band concept for insulator, conductor and semiconductor (elementary), intrinsic and extrinsic semi-conductor, conductivity, n- and p-type semiconductor, carrier and hole mobility and concentration Fermi level, density of electrons in the conduction band and density of holes in valence band, concentration of electrons in the CB of n- type and holes in VB of p-type semiconductor. Hall effect- hall voltage

and Hall coefficient and application. Fabrication and processing of semiconductors. Film formation and surface coating techniques. Applications of semiconductors. Preparation of single crystals. Microelectronic circuits.

Recommended Books:

1. Magnetic and Dielectric Properties of Materials: Basics, Theories and Experiments – by Mohammad Mahbubur Rahman, 2012
2. Chemical Processing of Advanced Materials: L. L. Hench and J. K. West (eds), John Wiley New York 1992.
3. P. Hagnmuller (ed): Preparative Methods in Solid State Chemistry, Academic Press, New York, 1972.
4. Sol-Gel Science, C. J. Brinker & G. W. Scherer, Academic Press, 1980.
5. Non-Oxide Technical & Engg. Ceramics, Ed. Stuart Hampshire, Elsevier Applied Science Pub. Ltd. 1986.
6. Semiconductor Material and Device Characterization, by Dieter K. Schroder, Springer, 3rd edition 2006.
7. Introduction to Semiconductor Materials and Devices by M.S.Tyagi, John Wiley & Sons, 2008
8. The Materials Science of Semiconductors by Angus Rockett, Springer, 2008
9. Ultrastructure Processing of Ceramics, glasses and Composites, Ed. L. L. Hench, D.R. Ulrich, John Wiley, New York 1984.