Name of the Programme: M. Sc -I (Inorganic Chemistry)

Course Code: CHI-502 **Title of the course:** Chemistry of Materials

Number of Credits: 04

Effective from AY: 2022-23

Prerequisites for the course:	Students should have studied Inorganic chemistry courses at M.Sc. Chemistry in semester I	
Course Objective:	1.To provide information about different types of materials. 2.To provide knowledge about different types of synthesis. 3.To be familiar with different solid state properties of materials.	
Content:	**1. Introduction to Materials Chemistry** Basic knowledge about properties, structure and applications of materials.	No of hours 1
	2. Structure and bonding in solid materials Crystal lattice; unit cell; Miller indices and planes; X-Ray diffraction method; Molecular, Metallic, Covalent and Ionic solids, Hydrogen bonding; Structural classification of binary and tertiary compounds; Spinel and Perovskite structures	6
	3. Crystal defects & Non-stoichiometry in Solids a. Types of defects: Point defects, Dislocations: Line defects and Plane defects. b. Oxygen deficient oxides; Metal deficient oxides and classification of non-stoichiometry.	6
	4. Materials preparation techniques a. Broad Classification of methods: Ceramic method, and Different wet chemical methods. b.Types of Materials: Powdered bulk materials, Single crystal and Thin films, Amorphous materials, and Nanomaterials. c. Preparation methods for different materials with their advantages and disadvantages: i. Powder materials: Co-precipitation method, Precursor method, Combustion method: Solid state and solution method, Precursor-combustion method, Sol-gel method, Spray roasting method, Freeze drying method. ii. Single crystals: (a) Growth from melt (b) from solution (c) using Flux method (d) Epitaxial growth of single crystal thin films: Using Chemical and Physical methods (e) Chemical vapour transport (f) Hydrothermal method (g) Dry high pressure method, electrochemical reduction method. iii. Amorphous Materials: Synthesis & applications. Nanomaterials: Synthesis, properties: structural, optical and magnetic and applications.	16
	5. Reactivity of Solid Materials	4

	Tarnish reactions, decomposition reaction, solid-solid reactions, addition reactions, double decomposition reaction, electron transfer reaction, solid-gas reactions, sintering, factors influencing reactivity of solids.	
	6. Phase Transformations in Solids Thermodynamic consideration, Burgers classification, structural change in phase transformation, Martensite transformation, temperature and pressure induced transformations, order-disorder transitions, electronic transition, transformation with a change in composition, enantiotropy and monotropy, Ehrenfest's classification.	6
	7. Electrical Properties Electrical conductivity, free electron theory, Fermi energy, insulators, semiconductors and conductors, band theory of semiconductor, Brilliouin zones, Hall effect, Peltier effect, Seebeck effect, photo conductivity and ionic conductivity, Superconductivity, BCS theory, Meissner effect, high temperature superconductor.	7
	8. Semiconductor Devices Diodes and transistors, Junction field effect transistor and metal oxide semiconductor field effect transistor, light meter, photodiode, phototransistor, solar cells, light emitting diodes. Laser materials.	5
	9. Optical and dielectric properties Luminescence and phosphorescence, piezoelectric, ferroelectric materials and applications, thermal conductivity, phonon interaction, thermal expansion coefficient.	4
	10. Magnetic properties Introduction to magnetism, behavior of substance in a magnetic field, magnetic moments, diamagnetism, paramagnetism, experimental determinations of susceptibility, ferromagnetism, anti-ferromagnetism and ferrimagnetism, magnetization of ferromagnetic substance.	5
Pedagogy:	Mainly lectures and tutorials. Seminars / term papers /assignments / presentations / self-study or a combination of some of these can also be used. ICT mode should be preferred. Sessions should be interactive in nature to enable peer group learning.	
References / Readings:	1. A.R. West, Solid State Chemistry and Its Applications, 1st Ed., John Wiley & Sons, Singapore, 1984 (reprint 2007). 2. L.V. Azaroff, Introduction to Solids, 1st Ed., Tata McGraw Hill, 2009, (33rd Reprint). 3. N. B. Hannay, Treatise on Solid State Chemistry Vol.4 Reactivity of Solids, 1st Ed.; Plenum Press, 1976. 4. D. K. Chakraborty, Solid State Chemistry, 2nd Ed.; New Age International Publisher, 2010.	

	5. H. V. Keer, Principles of the Solid State, 1st Ed., New Age International (P) Ltd., (Wiley Eastern Ltd,), 1993, (Reprint 2008). 6. C. N. R. Rao & K. J. Rao, Phase Transitions in Solid, 1st Ed.; McGraw Hill, 1977. 7. W. D. Callister, Materials Science and Engineering:An Introduction, 7th Ed.; John Wiley, 2007. 8. B. D. Fahlman, Materials Chemistry, 2nd Ed.; Springer, 2011. 9. H. R. Allcock, Introduction to materials chemistry, 1st Ed.; John Wiley & Sons, 2011. 10. C. N. R Rao & Gopalkrishnan, New directions in solid state chemistry, 2nd Ed.; Cambridge University Press, 1997. 11. R. S. Drago, Physical Methods in Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 2017. 12. G. C. Miessler, D. A. Tarr, Inorganic Chemistry, 3rd Ed.; Pearson, 2004.
Course outcomes:	1. Students will be able to explain different methods of material synthesis. 2. Students can explaineffect of size variations on solid state properties of materials. 3. Students can explain different types of defects and phase transformations in materials. 4. Students will be in position to describe magnetic, electrical, dielectric, optical, and semiconductor properties of materials.