

Teaching Plan 2024-25

B.Sc.(H), Chemistry V Sem

Subject: Novel Inorganic Solids (DSE-7)

Teacher: **Dr. Aditi Puri**

DISCIPLINE SPECIFIC ELECTIVE COURSE -7 (DSE-7): Novel Inorganic Solids

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Novel Inorganic Solids (DSE-7)	04	03	--	01	Class 12 th with Physics, Chemistry	--

Learning Objectives

The Objectives of this course are as follows:

- To familiarize the students with the characterization techniques of inorganic solids
- To familiarize the students with use and manifold applications of composites, carbon or high-tech ceramics

Learning Outcomes:

By studying this course, the students will be able to:

- Explain the mechanism of solid-state synthesis.
- Explain about the different characterization techniques and their principle.
- Explain the importance of composites and their applications.
- Discuss and explain the usage of solid materials in various instruments, batteries, etc. which would help them to appreciate the real-life importance of these materials

SYLLABUS OF DSE- 7

Unit 1: Synthesis of inorganic solids

(Hours: 5)

Conventional heat and beat method, Co-precipitation method, Sol-gel method, Hydrothermal method, Chemical vapor deposition (CVD), Ion-exchange and Intercalation method.

Unit 2: Characterization techniques of inorganic solids

(Hours: 10)

Powder X-ray Diffraction, UV-visible spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Fourier-Transform Infrared (FTIR) spectroscopy, Brunauer–Emmett–Teller (BET) surface area analyser, Dynamic Light Scattering (DLS)

Unit 3: Pigments

(Hours: 10)

Cationic, anionic and mixed solid electrolytes and their applications. Inorganic pigments – coloured, white and black pigments.

One-dimensional metals, molecular magnets, inorganic liquid crystals.

Unit 4: Composite materials

(Hours: 10)

Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, bio-nanocomposites, environmental effects on composites, applications of composites.

Unit 5: Speciality polymers

(Hours: 10)

Speciality polymers: Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene, polyaniline, and polypyrrole, applications of conducting polymers, ion-exchange resins and their applications.

Ceramic & Refractory: Introduction, classification, properties, manufacturing and applications of ceramics, refractory and superalloys as examples.

Practicals

Credits: 01

(Laboratory periods: 15 classes of 2 hours each)

1. Preparation of polyaniline and its characterization using UV-visible spectrophotometer.
2. Intercalation of hydrogen in tungsten trioxide and its conductivity measurement using conductometer.
3. Synthesis of the following inorganic pigments:
 - (i) PbCrO_4 / chrome yellow
 - (ii) Barium white
 - (iii) Prussian Blue
 - (iv) Malachite
4. Preparation of zeolite A and removal of Mg and Ca ions from water samples quantitatively using zeolite.
5. Determination of exchange capacity of cation exchange resins and anion exchange resins.

- Determination of a mixture of cobalt and nickel (UV-visible spectroscopy).
- Preparation of a disc of a ceramic compound using ball milling, pressing and sintering, and study its XRD.

Essential/recommended readings

Theory:

- West, A. R. (2014), **Solid State Chemistry and Its Application**, Wiley.
- Smart, L. E.; Moore, E. A., (2012), **Solid State Chemistry: An Introduction** CRC Press Taylor & Francis.
- Rao, C. N. R.; Gopalakrishnan, J. (1997), **New Direction in Solid State Chemistry**, Cambridge University Press.
- Poole Jr.; Charles P.; Owens, Frank J. (2003), **Introduction to Nanotechnology**, John Wiley and Sons.

Practicals:

- Orbaek, W.; McHale, M.M.; Barron, A. R.; **Synthesis and Characterization of Silver Nanoparticles for An Undergraduate Laboratory**, J. Chem. Educ. 2015, 92, 339–344.
- MacDiarmid, G.; Chiang, J.C.; Richter, A.F.; Somasiri, N.L.D.(1987), **Polyaniline: Synthesis and Characterization of the Emeraldine Oxidation State by Elemental Analysis**, L. Alcaer (ed.), Conducting Polymers, 105-120, D. Reidel Publishing.
- Cheng, K.H.; Jacobson, A.J.; Whittingham, M.S. (1981), **Hexagonal Tungsten Trioxide and Its Intercalation Chemistry**, Solid State Ionics, 5, 1981, 355-358.
- Ghorbani H.R.; Mehr, F.P; Pazoki, H; Rahmani, B.M.; **Synthesis of ZnO Nanoparticles by Precipitation Method**, Orient J Chem 2015, 31(2).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

Week	Topic
(Week 1)	Conventional heat and heat method, coprecipitation method, solgel method
(Week 2)	Chemical vapor deposition (CVD), Ion-exchange and Intercalation method
(Week 3)	Characterization Techniques: Powder X-ray Diffraction, UV-visible spectroscopy
(Week 4)	Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Fourier-Transform Infrared (FTIR) spectroscopy,
(Week 5)	Brunauer–Emmett–Teller (BET) surface area analyser, Dynamic Light Scattering (DLS)
(Week 6)	Pigments: Cationic, anionic and mixed solid electrolytes and their applications.
(Week 7)	Inorganic pigments – coloured, white and black pigments.

(Week 8)	One-dimensional metals, molecular magnets, inorganic liquid crystals.
(Week 9)	Composite materials: Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements,
(Week 10)	metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, bio-nanocomposites,
(Week 11)	environmental effects on composites, applications of composites.
(Week 12)	Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene, polyaniline and polypyrrole
(Week 13)	applications of conducting polymers, ion-exchange resins and their applications. Assignment to be given
	Break
(Week 14)	Revision and class test
(Week 15)	Ceramic & Refractory: Introduction, classification, properties, manufacturing
(Week 16)	applications of ceramics, refractory and superalloys as examples. Class test and Previous year question papers discussion