



**JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J. T. LALVANI COLLEGE OF COMMERCE
AUTONOMOUS**

"A" Road, Churchgate, Mumbai - 400 020, India.

**Affiliated to
University of Mumbai**

Program: M.Sc. in Chemistry
(Inorganic)

Course: Coordination and Bioinorganic Chemistry

Semester III

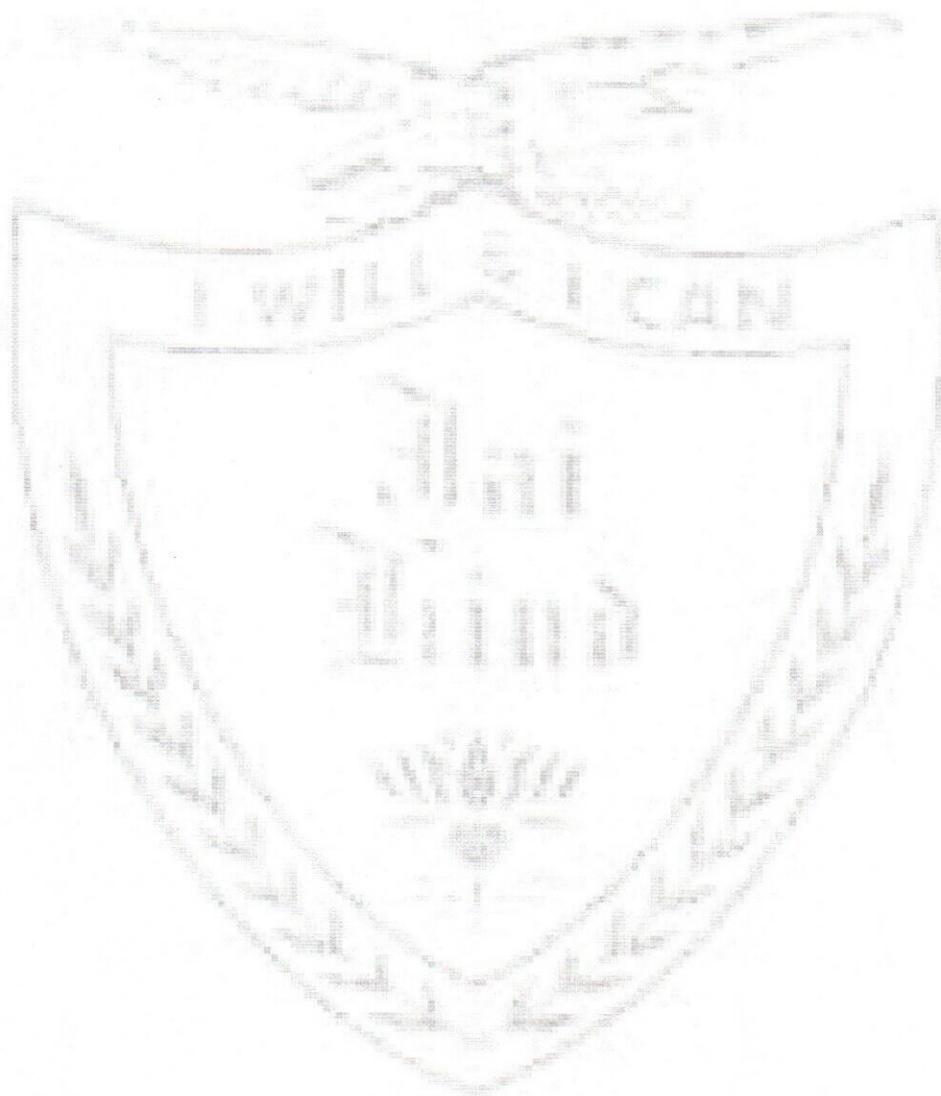
**Credit Based Semester and Grading System (CBSGS) with effect from
the academic year 2022-23**



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M.Sc. Coordination and Bioinorganic Chemistry Syllabus

Semester III			
Course Code	Course Title	Credits	Lectures/Week
PSCHE2301	Coordination and Bioinorganic Chemistry	04	04




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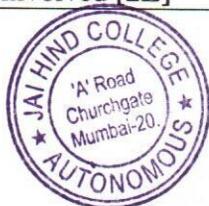
Semester III

Course: PSCHE2301	Coordination and Bioinorganic Chemistry (Credits: 04 Lectures/Week: 04)	
	Structure, Bonding and Stereochemistry of Coordination Compounds, Electronic spectra and magnetic properties of complexes, advanced bioinorganic chemistry and reactivity of chemical species.	
	Objectives: <ol style="list-style-type: none"> 1) To understand Structure, Bonding & Stereochemistry of coordination Compounds. 2) To introduce the electronic spectra and magnetic properties of complexes. 3) To describe the concept of Advanced Bioinorganic Chemistry & reactivity of chemical species. Outcomes: <ol style="list-style-type: none"> 1) To explain MOT stereochemistry of coordination complexes. 2) To calculate magnetic moment and magnetic susceptibility. 3) To summarise the role of metal ions in biological electron transfer processes. 4) To explain reactivity of chemical species with examples. 	
Unit I	Structure, Bonding & Stereochemistry of Coordination Compounds 1.1 Structure and Bonding: [10L] <ol style="list-style-type: none"> i. Molecular Orbital Theory for complexes with coordination number 4 and 5 for central ion (sigma as well as pi bonding) ii. Angular Overlap Model for octahedral complexes and tetrahedral complexes- sigma and pi bond 1.2 Stereochemistry of Coordination compounds: Chirality and fluxionality of coordination compounds with higher coordination numbers; geometries of coordination compounds from coordination number 6 to 9 [5L]	15L
Unit II	Electronic Spectra & Magnetic properties of Complexes 2.1 Magnetic properties of complexes:[8L] <ol style="list-style-type: none"> i. Origin of magnetism, classification according to the magnetic properties: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism and ferrimagnetism ii. Magnetic moment from magnetic susceptibility, Curie equation and Curie temperature, Curie-Weiss law, Neel temperature 	15L



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	<p>iii. Thermal energy and magnetic moment: multiplet width greater than kT; temperature independent paramagnetism</p> <p>iv. Magnetic susceptibility and spin only formula, spin and orbital contribution to magnetic moment, spin cross over</p> <p>v. Determination of magnetic susceptibility by Gouy, Faraday, Quinke's and NMR methods</p> <p>2.2 Electronic Spectra of complexes: [7L]</p> <p>i. Recapitulation- construction of Orgel diagram and Tanabe Sugano diagram, evaluation of $10Dq$ and B from Tanabe-Sugano diagram from electronic absorption spectra of octahedral complexes (d^1-d^9)</p> <p>ii. Determination of spectral terms for ground state and excited state using pigeon hole diagram, energy of terms, Hund's rules, spin orbit (L-S) coupling, selection rules and intensities, crystal field splitting of the terms in ligand field.</p> <p>iii. Comparing the spectra of octahedral, tetrahedral and square planar complexes of Nickel(II); Charge transfer spectra.</p>	
Unit III	<p>Advanced Bioinorganic Chemistry</p> <p>3.1 Coordination geometry of the metal ion and functions. [3L]</p> <p>3.2 Zinc in biological systems: carbonic anhydrase, protolytic enzymes, e.g. carboxy peptidase [4L]</p> <p>3.3 Role of metal ions in biological electron transfer processes: iron sulphur proteins [4L]</p> <p>3.4 Less common ions in biology e.g. Mn (arginase, structure and reactivity), Ni (urease, structure and activity) Biomineralization [4L]</p>	15L
Unit IV	<p>Reactivity of Chemical Species</p> <p>4.1 Recapitulation: definition of Lewis acids and bases, classification of Lewis acids and bases on the basis of frontier molecular orbital topology, reactivity matrix of Lewis acids and bases [2L]</p> <p>4.2 Acid base reactions: On the basis of Atomic/Molecular orbitals involved [2L]</p>	15L




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	<p>4.3 Redox reactions: Redox reactions in aqueous, non-aqueous and solvent free media [3L]</p> <p>4.4 Latimer & Frost Diagrams [2L]</p> <p>4.5 Lewis acids: Group characteristics of group 1 and group 13-17 elements[3L]</p> <p>4.6 Oxoacids: Pauling rules to determine strength of oxoacids, classification and structural anomalies; oxoanions and oxocations [3L]</p>	
<p>Standard References:</p> <ol style="list-style-type: none"> 1. Gispert J.R., Coordination Chemistry, Wiley-VCH, 2008 2. Banerjee D., Coordination Chemistry, 3rd Edition, Asian Books Pvt. Ltd. 2009 3. Gopalan R., Ramalingam V., Concise Coordination Chemistry, Vikas Publishing House Pvt. Ltd. 2007 4. Wulfsberg G., Inorganic Chemistry, Viva Books Pvt. Ltd. 2002 5. Douglas B., McDaniel D., Alexandar J., Concepts and Models of Inorganic Chemistry, 3rd Edition, John Wiley and Sons, Inc. 2001 6. https://www.meta-synthesis.com/webbook/13_lab-matrix/LAB_matrix.php for Reactivity of Chemical Species 7. Pfenning B.W., Principles of Inorganic Chemistry, 1st Edition, Wiley Publication 2015 8. Dutta R.A., Syamal A., Elements of Magnetochemistry, 2nd Edition, Affiliated East West Press Pvt. Ltd. 1993 9. Huheey J.E., Keiter E.A., Keiter R.L., Medhi O.K., Inorganic Chemistry-Principles of Structure and Reactivity, 4th Edition, Pearson 2006 10. Lever A.B.P., Inorganic Electronic Spectroscopy, Elsevier Publishing Company 1968 		

Evaluation Scheme

- **Continuous Assessment (CA) – 40 Marks**
 - Knowledge and Application based: Objective test of 20 Marks
 - Skill based (20 marks): Learner will be assessed on relevant skills pertaining to the course content of a particular paper which could involve but not limited to
 - Oral Presentations on relevant topics
 - Review writing/Worksheets etc.

- **Semester End Examination (SEE)- 60 Marks**




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Program: M.Sc. in Chemistry
(Inorganic)

Course: Practical Coursework I

Semester III

**Credit Based Semester and Grading System (CBSGS) with effect from
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M.Sc. Practical Coursework I Syllabus

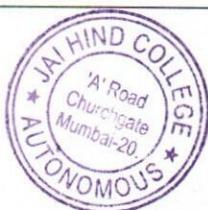
Semester III			
Course Code	Course Title	Credits	Lectures/Week
PSCHEP2301	Practical Coursework I	02	02




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Semester III – Practical

Course: PSCHEP2301	Practical Coursework I (Credits: 02, Practicals/Week: 02) PSCHEP2301: Practical Coursework I Objectives: To equip the students with practical skills in instrumental & non-instrumental methods of analysis. Outcomes: Learner is expected to acquire laboratory skills in calibration and use of instruments for chemical analysis and also design experiments for instrumental and non-instrumental assays. <ol style="list-style-type: none">1. To titrate potassium ferrocyanide with zinc sulphate and hence to determine the formula of zinc ferrocyanide. (Conductometrically)2. To determine the E° of quinhydrone electrode potentiometrically.3. To determine the degree of hydrolysis of ammonium chloride and hence to determine the dissociation constant of the base. (pH metrically)4. To determine the energy of activation and other thermodynamic parameters of activation for the acid catalyzed hydrolysis of methyl acetate.5. To determine the molar mass of a non-volatile solute by cryoscopy method.6. To determine the chain linkage in poly(vinyl alcohol) from viscosity measurements. REFERENCES: <ol style="list-style-type: none">1. Athawale V.D., Mathur P., Experimental Physical Chemistry, New Age International Publishers, 2017.2. Vishwanathan B., Raghavan P.S., Practical Physical Chemistry, Viva Books Private Limited, 20053. James A.M., Prichard F.E., Practical Physical Chemistry, 3rd Edition, Longman, 19744. Lewitt B.P., Findlay's Practical Physical Chemistry, 9th Edition, 19735. Brennan C.D., Tipper C.F.H., A Laboratory Manual of Experiments in Physical Chemistry, McGraw Hill 19676. Daniel F. & Others, Experimental Physical Chemistry, 1965, Kogakasha Co Ltd. Tokyo7. Jeffery G.H., Bassett J., Mendham J., Denney R.C., Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition, Longman Scientific & Technical John Wiley & Sons Inc., New York, 19898. Woolins J.D., Inorganic Experiments, VCH, Weinheim, 19949. Palmer W.G., Experimental Inorganic Chemistry, CUP Archive 195410. Raj G., Advanced Practical Inorganic Chemistry, Krishna Prakashan Media (P) Ltd, 201311. Daniel F. & Others, Experimental Physical Chemistry, 1965, Kogakasha Co Ltd. Tokyo
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Evaluation Scheme

- Semester End Examination (SEE)- 50 Marks



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Program: M.Sc. in Chemistry
(Inorganic)

Course: Atomic Molecular Structure and Spectroscopy

Semester III

**Credit Based Semester and Grading System (CBSGS) with effect from
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M.Sc. Atomic Molecular Structure and Spectroscopy Syllabus

Semester III			
Course Code	Course Title	Credits	Lectures/Week
PSCHE2302	Atomic, Molecular Structure and Spectroscopy	04	04




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	<p>MO wave function of Hydrogen molecule ion (H_2^+); Ground state electronic energy, LCAO coefficients and orthonormal Mos, Electron density and bonding in H_2^+, Physical Representation & symmetry in σ & σ^* MOs; GS of H_2 molecule, Graphical representation, shortcomings of simple MO theory[4L]</p> <p>2.3 Valence Bond Theory: Hydrogen molecule ion, Heitler and London theory for H_2 molecule, wave function, evaluation of Energy E_+, Stability of the bond, electron density distribution, Antisymmetry of wave function, shortcomings of Heitler-London Treatment, resonance [4L]</p> <p>2.4 Comparison of VB and MO theories[1L]</p> <p>2.5 Electronic spectra of molecules: Molecular term symbols for linear molecules, selection rules, characteristics of electronic transitions, Franck-Condon principle, types of electronic transitions- d-d, vibronic, charge transfer, $\pi-\pi^*$, $n-\pi^*$ transitions, fate of electronically excited states. [5L]</p>	
Unit III	<p>Molecular Spectroscopy I</p> <p>3.1 Rotational Spectroscopy: Recapitulation- rotational spectrum of diatomic molecule, rigid rotor, selection rule & nature of spectrum, Einstein coefficients, classification of polyatomic molecules, rotational spectra of polyatomic molecules, Stark modulated microwave spectrometer.[5L]</p> <p>3.2 Infrared spectroscopy: Vibrational motion, degree of freedom, vibrational spectrum of diatomic molecule and simple harmonic oscillator, selection rule and nature of spectrum; Anharmonic oscillator, Rotational-vibrational spectrum, breakdown of Born-Oppenheimer approximation, combinational differences, vibrations of polyatomic molecules, rotational fine structure of vibrational spectrum of polyatomic molecules. IR absorption bands of metal-donor atom, effect of complexation on the IR spectrum of ligands like NH_3, CN^-, CO, olefins ($C=C$) and $C_2O_4^{2-}$[5L]</p> <p>3.3 Raman Spectroscopy: Classical theory of molecular polarizability, pure rotational, vibrational and vibration-rotation spectra of diatomic and polyatomic molecules; polarization and depolarization of Raman lines; correlation between IR and Raman spectroscopy; instrumentation. [5L]</p>	15L

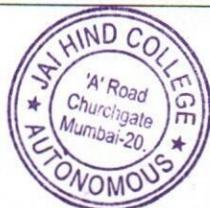


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Semester III – Theory

Course: PSCHE2302	Atomic, Molecular Structure & Spectroscopy (Credits: 04 Lectures/Week: 04)	
	Atomic structure, atomic spectroscopy; Molecular structure and molecular spectroscopy	
	Objectives: <ol style="list-style-type: none"> 1. To understand advantages of approximation methods for solving complex problems. 2. To explain bonding in simple molecules with Valence bond theory, Molecular orbital theory 3. To understand the principles and theories of rotational, vibrational Raman, ESR, Mossbauer and NQR spectroscopy. Outcomes: <ol style="list-style-type: none"> 1. To apply approximation methods for solving complex problems. 2. To describe bonding in simple molecules using MOT and VBT. 3. To interpret rotational, vibrational Raman, ESR, Mossbauer and NQR spectra of different molecules. 	
Unit I	Atomic Structure & Spectroscopy: <ol style="list-style-type: none"> 1.1 Introduction to approximate methods in Quantum Mechanics & Multi-electron atoms [9L] <ol style="list-style-type: none"> (i) Variation Theorem, linear and nonlinear variation functions. [2L] (ii) Perturbation Theory, non-degenerate perturbation theory, first order wave function correction, first order and second order energy correction. [3L] (iii) Application of variation and perturbation theory to ground state of Helium atom. [2L] (iv) Multi-electron atoms: Antisymmetry and Pauli principle, Slater determinants, Hartree-Fock and configuration interaction wave functions. [2L] 1.2 Atomic Spectroscopy [6L] <ol style="list-style-type: none"> (i) Term symbols for multi electron atoms like He, Li, Be, B etc. [2L] (ii) Exchange of interactions and multiplicity of states. [2L] (iii) Anomalous Zeeman Effect and Paschen Back effect. [2L] 	15L
Unit II	Molecular Structure & Electronic Spectroscopy: <ol style="list-style-type: none"> 2.1 Theory of Chemical Bonding in diatomic molecules: Born-Oppenheimer approximation.[1L] 2.2 Molecular Orbital Theory: LCAO Approximation, LCAO- 	15L




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Unit IV	<p>Molecular Spectroscopy II</p> <p>4.1 Electron Spin Resonance: Fundamentals- g Values; fine, hyperfine and superhyperfine structures; anisotropy & spin polarization; line widths; experimental considerations- sample, spectrometer & instrumentation; Applications- single electron & multielectron systems.[6L]</p> <p>4.2 Mossbauer Spectroscopy: Basic principles; spectrum and its parameters; experimental considerations- sample, temperature and instrumentation (sources and absorber; motion devices, detection, reference substances and calibration); isomer shift, quadrupole splitting, magnetic interaction, additive model; Applications- low and high spin Fe(II) and Fe(III) compounds and complexes; tin-119 and Iodine-127, Iodine-129 [6L]</p> <p>4.3 Nuclear Quadrupole Resonance: Fundamentals- origin of EFG, asymmetry parameter, effects of magnetic field; experimental considerations; Applications- halogens, Group V elements, Transition metals; Nuclear Quadrupole Resonance Spectroscopy- ENDOR, ELDOR, EWDOR[3L]</p>	15L
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Standard References:

Unit I & II

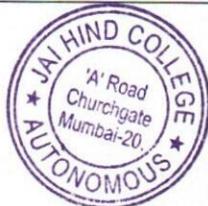
1. Prasad R.K., Quantum Chemistry, 3rd Edition, New Age International Publishers, 2006
2. Levine I.N., Quantum Chemistry, 5th Delhi Edition (2000), Pearson Educ. Inc.,
3. McQuarrie D.A., Quantum Chemistry, 2nd Edition, University Science Books, California
4. Puri B.R., Pathania M.S., Sharma L.R., Principles of Physical Chemistry, 47th Edition, 2020, Vishal Publishing Co.

Unit III & IV

5. Banwell C.N., McCash E.M., Fundamentals of Molecular Spectroscopy, 4th Edition, Tata-McGraw-Hill, 1994
6. Gupta M.L., Atomic and Molecular Spectroscopy, New Age International Publishers, 2001
7. Parish R.V., NMR, NQR, EPR and Mossbauer spectroscopy in Inorganic Chemistry, Publisher E. Horwood (1990)
8. Rao C.N.R., Chemical Applications of Infrared Spectroscopy, Academic Press N.Y. (1963)

Additional References:

9. Laidler and Miser, Physical Chemistry, 2nd Edition, CBS publishers, New Delhi
10. Silbey and Alberty, Physical Chemistry, 3rd Edition, John Wiley and Sons, 2000.
11. Atkins P.W., Physical Chemistry, Oxford University Press, 6th Edition, 1998.
12. McQuarrie D.A., Simon J.D., Physical Chemistry: A Molecular Approach, (1998) Viva Books, New Delhi
13. Murrell J.N., Kettleland S.F.A., Tedder J.M., Valence Theory, 2nd Edition (1965),



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John Wiley, New York Edition

14. Chandra A.K., Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi Edition (1994)
15. House J.E., Fundamentals of Quantum Chemistry, 2nd Edition, Academic Press, 2005
16. Littlefield T.A., Thorley N., Atomic and Nuclear Physics- An Introduction, Van Nostrand, 1979.
17. Randhawa H.S., Modern Molecular Spectroscopy, McMillan India Ltd. 2003
18. Aruldas G., Molecular Structure and Spectroscopy, Prentice-Hall of India, 2001
19. Hollas J.M., Modern Spectroscopy, 4th Edition, John Wiley and Sons, 2004
20. Straughan B.P., Walker S., (Eds.) Spectroscopy- Vol 1-3, Chapman and Hall, New York, 1976
21. Pavia D.L., Lampman G.M., Kriz G.S., Introduction to Spectroscopy, 3rd Edition, Thomson, Brooks, Cole, 2001

Evaluation Scheme

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 - Knowledge and Application based: Objective test of 20 Marks
 - Skill based (20 marks): Learner will be assessed on relevant skills pertaining to the course content of a particular paper which could involve but not limited to
 - Oral Presentations on relevant topics
 - Review writing/Worksheets etc.
- **Semester End Examination (SEE)- 60 Marks**



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**Program: M.Sc. in Chemistry
(Inorganic)**

Course: Practical Coursework II

Semester III

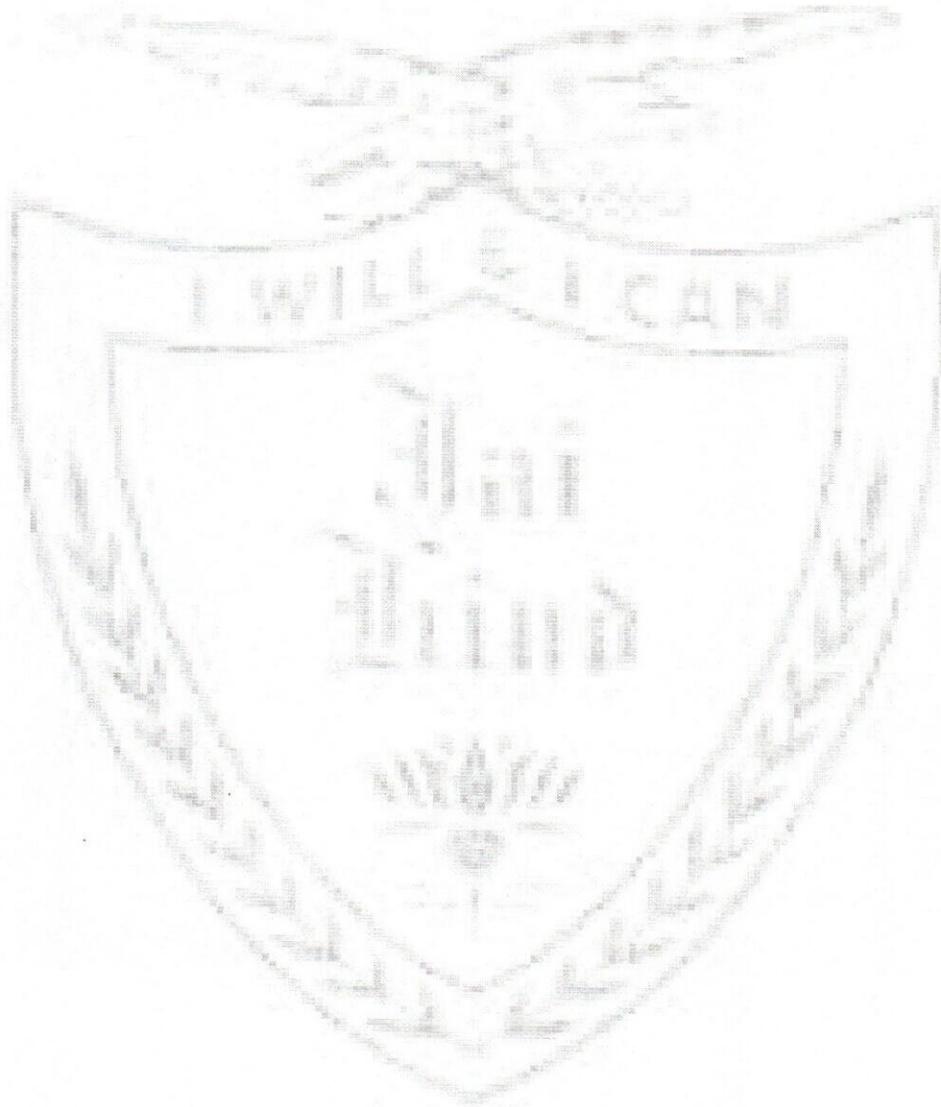
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M.Sc. Practical Coursework II Syllabus

Semester III			
Course Code	Course Title	Credits	Lectures/Week
PSCHEP2302	Practical Coursework II	02	02




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Course:
PSCHEP2302

Practical Coursework II (Credits: 02, Practical/Week: 02)

PSCHEP2302: Practical Coursework II

Objectives: To equip the students with practical skills in synthesis and characterisation of coordination compounds

Outcomes: Learner will acquire laboratory skills in the synthesis of coordination complexes and its characterization using instrumental methods.

1. Solvent Extraction:
 - a) Separation of Co and Ni using n-butyl alcohol and estimation of Co
 - b) Separation of Fe and Mo using isoamyl alcohol and estimation of Fe
2. Preparation of $\text{Co}(\alpha\text{-nitroso-}\square\text{-naphthol})_3$
3. Preparation of Trans-bis(glycinato)Cu(II)
4. Determination of CFSE values of hexa-aqua complexes of Ti^{3+} and Cr^{3+}
5. Determination of Racah parameters for complex $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ & $[\text{Ni}(\text{en})_3]^{2+}$
6. Synthesis of Ag Nanoparticles using tricitrate method and calculate the band gap using UV-Vis spectroscopy.
7. Synthesis of ZnO nanoparticles using chemical route and calculate the particle size by UV-Visible spectroscopy.

REFERENCES:

12. Athawale V.D., Mathur P., Experimental Physical Chemistry, New Age International Publishers, 2017.
13. Vishwanathan B., Raghavan P.S., Practical Physical Chemistry, Viva Books Private Limited, 2005
14. James A.M., Prichard F.E., Practical Physical Chemistry, 3rd Edition, Longman, 1974
15. Lewitt B.P., Findlay's Practical Physical Chemistry, 9th Edition, 1973
16. Brennan C.D., Tipper C.F.H., A Laboratory Manual of Experiments in Physical Chemistry, McGraw Hill 1967
17. Daniel F. & Others, Experimental Physical Chemistry, 1965, Kogakasha Co Ltd. Tokyo
18. Jeffery G.H., Bassett J., Mendham J., Denney R.C., Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition, Longman Scientific & Technical John Wiley & Sons Inc., New York, 1989
19. Woolins J.D., Inorganic Experiments, VCH, Weinheim, 1994
20. Palmer W.G., Experimental Inorganic Chemistry, CUP Archive 1954

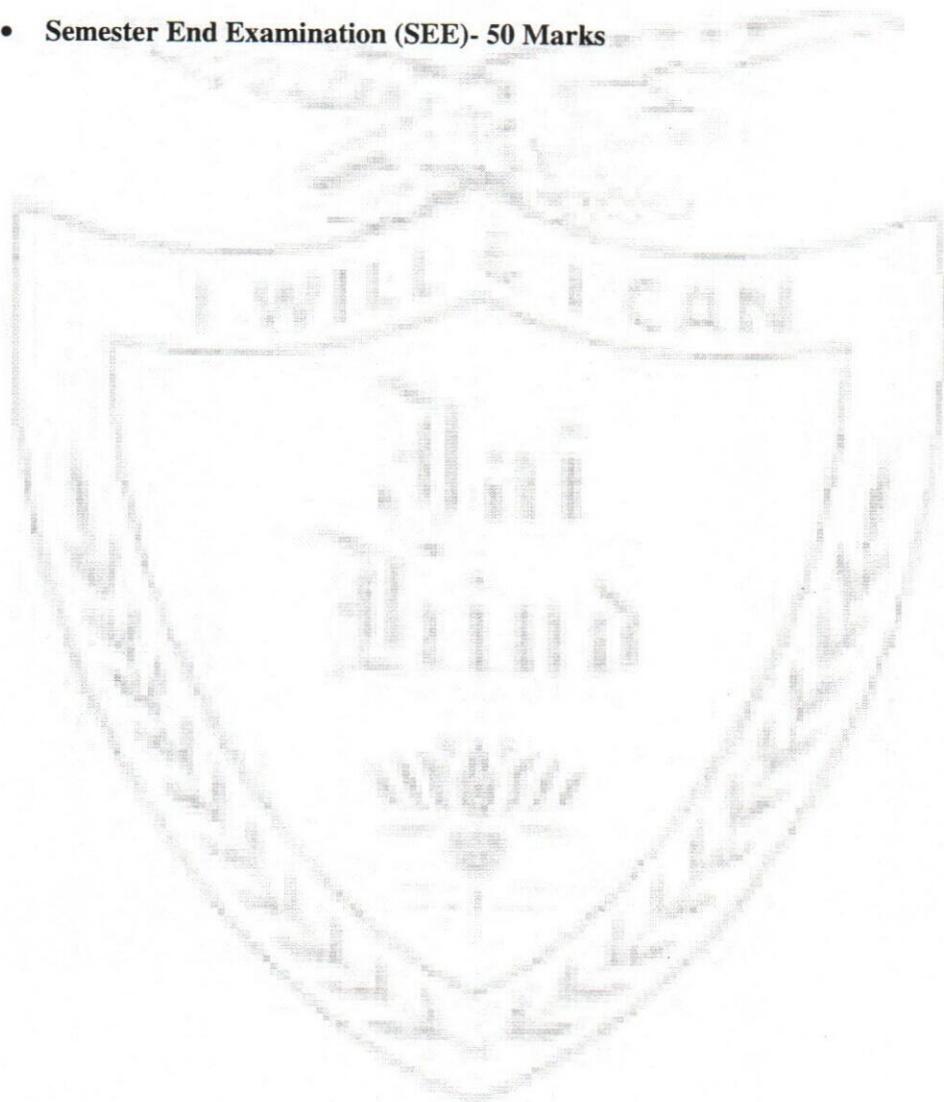



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	<p>21. Raj G., Advanced Practical Inorganic Chemistry, Krishna Prakashan Media (P) Ltd, 2013</p> <p>22. Daniel F. & Others, Experimental Physical Chemistry, 1965, Kogakasha Co Ltd. Tokyo</p>
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Evaluation Scheme

- Semester End Examination (SEE)- 50 Marks




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Program: M.Sc. Chemistry
(Inorganic)

Course: Nano chemistry and Nanotechnology

Semester III

**Credit Based Semester and Grading System (CBSGS) with effect from
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**PRINCIPAL
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M.Sc. Nano chemistry and Nanotechnology Syllabus

Semester III			
Course Code	Course Title	Credits	Lectures/Week
PSCHE2303	Nanochemistry and Nanotechnology	04	04




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Semester III – Theory

Course: PSCHE2303	Nanochemistry and Nanotechnology (Credits: 04 Lectures/Week: 04)	
	Introduction to nanotechnology & synthesis, characterisation and applications of nanomaterials; environmental aspects of nanotechnology	
	Objectives: <ol style="list-style-type: none"> 1) To understand various chemical and physical methods for the synthesis of diverse types of nanomaterials (0D, 1D and 2D). 2) To establish various characterization techniques for nanomaterials 3) To introduce different application of nanotechnology in the field of energy. Outcomes: <ol style="list-style-type: none"> 1) To explain the synthesis of metal nanoparticles. 2) To assess physical properties of materials and make decision on their application in energy conversion devices. 3) To describe the principles of Scanning Electron Microscope (SEM) and its use in characterizing nanoparticles. 4) To identify application of nanotechnology in environmental science and biomedical field. 	
Unit I	Introduction to Nanomaterials and Nanotechnology <ol style="list-style-type: none"> 1.1 Introduction and Properties: The science of Nano, classification, types, size effect and surface effects on properties, mechanical-physical-chemical properties (in brief). [4L] 1.2 Synthesis of Nanomaterials: [7L] <ol style="list-style-type: none"> i. Chemical methods (Recapitulation) ii. Bio-inspired synthesis: Green synthesis using plant extracts & microorganisms, self-assembly iii. Physical Methods: Template based self-assembly (SAM), Ball Milling, Vapor deposition and different types of epitaxial growth techniques, Laser Ablation, pulsed laser deposition, Magnetron sputtering- deposition progress and Lithography. 	15L
Unit II	Advanced Characterization of Nanomaterials <ol style="list-style-type: none"> 2.1 Preparation of environment: Clean rooms- specifications and design, air and water purity, requirements for particular processes, Vibration free environments- facilities required; working practices, sample cleaning, chemical purification, chemical and biological contamination, safety issues, 	15L



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	<p>flammable and toxic hazards, biohazards.[3L]</p> <p>2.2 Characterization techniques for nanomaterials:[12L]</p> <p>i. Optical spectroscopy: UV-Vis, FTIR, photoluminescence and Raman spectroscopy.</p> <p>ii. X-ray diffraction technique (with reference to PXRD of SMOs, metal oxides and nanocomposites)</p> <p>iii. Electron microscopy: Scanning Electron Microscopy – EDAX, Transmission Electron Microscopy including high-resolution imaging & SAED, Confocal microscopy</p> <p>iv. Surface Analysis techniques- BET, AFM, SPM, SPOM, STM, ESCA, SIMS- Nanoindentation, Ellipsometer</p>	
Unit III	<p>Applications of Nanomaterials</p> <p>3.1 Sensors: Sensors for Small molecules, volatile compounds, gases, biosensor, ion selective, humidity sensor, wearable sensor (materials based on SMOs, polymer nanocomposites, quantum dots) [7L]</p> <p>3.2 Fuel Cells, batteries & hydrogen storage: Polymer membranes for fuel cells, Acid/alkaline fuel cells, design of fuel cells, principle, design and role of carbon based nanostructures in Li-ion batteries and Na-ion batteries; Hydrogen storage [5L]</p> <p>3.3 Other Applications: Quantum dots for light emitting diodes, nanotube/nanowire-based field effect transistors; nanoparticles as catalysts; detection, diagnosis and mapping using nanomaterials.[3L]</p>	15L
Unit IV	<p>Environmental Nanotechnology</p> <p>4.1 Nanomaterials for environmental protection: Nanotechnology for waste reduction and waste water treatment, water purification (nano porous polymers), Nanoengineering materials, nanodevices and nano systems for pollution prevention and improved energy efficiency[6L]</p> <p>4.2 Diagnosis and treatment of diseases using nanoparticles: Cancer treatment and biomedical field. [2L]</p> <p>4.3 Environment related case studies on Nanomaterials: Toxicity of nanoparticles, screening of nanomaterials for understanding potential effects to human health and the environment. Mapping of the environmental fate of</p>	15L



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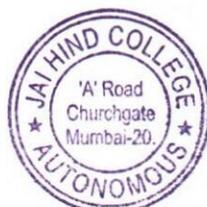
	nanomaterials. Relationships between key properties of nanomaterials and their environmental fate, transport, transformation, bio-distribution, toxicity, health impact, safety and ethics. [7L]	
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Standard References:

1. Kulkarni S.K., Nanotechnology: Principles and Practices, Capitol Publishing Company (2007)
2. Goyal R.K., Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization Techniques and Applications, CRC press, Taylor and Francis (2018)
3. Rao C.N.R., Muller & Cheetham A.K., Eds. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim (2004)
4. Vollath D., Nanomaterials- An Introduction to Synthesis, Properties and Applications Wiley-VCH, 2nd Edition (2013)
5. Environmental Chemistry for a Sustainable World, Volume 1: Nanotechnology and Health Risk Editors: Lichtfouse, Schwarzbauer, Robert

Evaluation Scheme

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Program: M.Sc. Chemistry

(Inorganic)

Course: Research Methodology

Semester III

**Credit Based Semester and Grading System (CBSGS) with effect from
the academic year 2022-23**




**PRINCIPAL
JAI HIND COLLEGE**

M.Sc. Research Methodology Syllabus

Semester III			
Course Code	Course Title	Credits	Lectures/Week
PSCHEP2303	Research Methodology	02	02




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Semester III – Theory

Course: PSCHEP2303	Research Methodology (Credits: 02, Practical /Week: 02) Objectives: <ol style="list-style-type: none"> 1) To understand a general definition of research design. 2) To familiarize with how to write a good introduction to educational research study and the components that comprise such an introduction. Outcomes: <ol style="list-style-type: none"> 1) To identify a research problem stated in a study. 2) To distinguish a purpose statement, a research question or hypothesis and a research objective.
	<p>PSCHEP2303: Research Methodology</p> <p>Unit Ia: Research Methodology: Print: Primary, Secondary and Tertiary sources. Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, textbooks, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples. Digital: Web sources, E-journals, Journal access, TOC alerts, Hot articles, Citation Index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki-databases, ChemSpider, Science Direct, SciFinder, Scopus. Information Technology and Library Resources: The Internet and World wide web, Internet resources for Chemistry, finding and citing published information.</p> <p>Unit Ib: Methods of scientific research and writing scientific papers: Reporting practical and project work, writing literature surveys and reviews, organizing a poster display, giving an oral presentation. Writing Scientific Papers: Justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work, writing ethics, avoiding plagiarism.</p> <p>Unit II: Teaching Aptitude: Teaching: Concept, Objectives, Levels of teaching (Memory, Understanding and Reflective), Characteristics and basic requirements. 2. Learner's characteristics: Characteristics of adolescent and adult learners (Academic, Social, Emotional and Cognitive), Individual differences. 3. Factors affecting teaching related to: Teacher, Learner, Support material, Instructional facilities, Learning environment and Institution. 4. Methods of teaching in Institutions of higher learning: Teacher centred vs. Learner centred methods; Off-line vs. On-line methods (Swayam, Swayam Prabha, MOOCs etc.). 5. Teaching Support System: Traditional, Modern and ICT based. 6. Evaluation Systems: Elements and Types of evaluation, Evaluation in Choice Based Credit System in Higher education, Computer</p>



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based testing, Innovations in evaluation systems.

Unit III: Communication:

Communication: Meaning, types and characteristics of communication; Effective communication: Verbal and Non-verbal, Inter-Cultural and group communications, Classroom communication; Barriers to effective communication; Mass-Media and Society.

Unit IV: Mathematical Reasoning and Aptitude:

1. Types of reasoning. 2. Number series, Letter series, Codes and Relationships. 3. Mathematical Aptitude (Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc.).

Unit V: Data Interpretation:

1. Sources, acquisition and classification of Data. 2. Quantitative and Qualitative Data. 3. Graphical representation (Bar-chart, Histograms, Pie-chart, Table-chart and Line-chart) and mapping of Data. 4. Data Interpretation

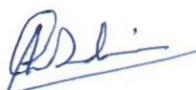
REFERENCES:

1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J., & Jones, A., (2011), Practical skills in Chemistry, 2 nd Ed., Prentice Hall, Harlow
2. Hibbert, D. B. & Gooding, J. J. (2006) Data Analysis for Chemistry Oxford University Press.
3. Topping, J., (1984) Errors of Observation and their Treatment 4 th Ed., Chapman Hill, London.
4. Levie, R. De. (2001) How to use Excel in Analytical Chemistry and in general scientific data analysis Cambridge University Press.

Evaluation Scheme

- Semester End Examination (SEE)- 50 Marks




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&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)**

"A" Road, Churchgate, Mumbai - 400 020, India.

**Affiliated to
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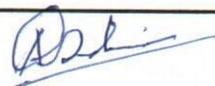
Program: M.Sc. Chemistry
(Inorganic)

Course: Applications of Materials and Nuclear Chemistry

Semester III

**Credit Based Semester and Grading System (CBSGS) with effect from
the academic year 2022-23**




**PRINCIPAL
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M.Sc. Application of Materials and Nuclear Chemistry Syllabus

Semester III			
Course Code	Course Title	Credits	Lectures/Week
PSCHE2304	Application of Materials and Nuclear Chemistry	04	04




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Semester III – Theory

Course: PSCHE2304	Application of Materials & Nuclear Chemistry (Credits: 04 Lectures/Week: 04)	
	Metals and alloys, mechanical properties of solid materials, applications of materials as lasers and super conductors & Nuclear chemistry	
	Objectives: <ol style="list-style-type: none"> 1) To understand advanced concept of Metals and alloys. 2) To introduce the mechanical properties of solid materials. 3) To introduce the concept, working and application of lasers. 4) To discuss the concept and application of nuclear chemistry. Outcomes: <ol style="list-style-type: none"> 1) To explain the growth of single crystal, defect and atomic diffusion in solids. 2) To identify mechanical properties of solid materials. 3) To classify different laser and its application in Chemistry. 4) To describe the concept and application of nuclear chemistry. 	
Unit I	Metals and alloys: <ol style="list-style-type: none"> 1.1 Solidification of metals and alloys- homogenous and heterogenous nucleation, growth of crystals, growth of silicon single crystal. [4L] 1.2 Metallic solid solutions- substitutional and interstitial solid solutions. [3L] 1.3 Crystalline imperfections- point, line and boundary defects [4L] 1.4 Atomic diffusions in solids- diffusion mechanisms, steady state and non-steady state diffusions- impurity diffusion into silicon wafers for integrated circuits. [4L] 	15L
Unit II	Mechanical properties of Solid Materials: <ol style="list-style-type: none"> 1. Stress and strain in metals- Engineering stress and engineering strain, shear stress and shear strain, the tensile test and engineering stress- strain diagram, modulus of elasticity, yield strength [5L] 2. Hardness and hardness testing, plastic deformations of metals in single crystals, plastic deformation of polycrystalline metals, solid solution, strengthening of metals. [5L] 3. Fracture of metals-ductile and brittle fracture, toughness and impact testing, fatigue of metals, the creep test, creep-rupture test. [5L] 	15L



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Unit III	Lasers and super conductors 3.1 Lasers in Chemistry [10L] i. General principles of LASER action- Population inversion, cavity and mode characteristics, Q-switching, Mode locking [2L] ii. Practical lasers- solid state lasers- Ruby, neodymium, gas lasers- He, Ne, Ar, Kr, Carbon dioxide, Chemical and exciplex Lasers, Dye lasers, LED and Semiconductor Lasers. [5L] iii. Applications of Lasers in Chemistry: Spectroscopy at high photon fluxes, collimated beams, precision specified transitions, isotope separation, study of fast reactions using pulsed techniques. [3L] 3.2 Superconducting solid materials: Band theory of electrical conductivity, Bardeen-Cooper-Schriffer Theory of super conductivity, the superconducting state, high critical temperature super conductors, magnetic properties of superconductors. [5L]	15L
Unit IV	Nuclear Chemistry 4.1 Charged particle accelerator: linear accelerator, cyclotron, Betatron, synchro-cyclotron, synchrotron [4L] 4.2 Nuclear forces: characteristics and Meson field theory of nuclear forces [2L] 4.3 Nuclear Models: liquid drop model, Fermi Gas model, Shell model, Collective model, Optical model [4L] 4.4 Applications of Nuclear radiations: geological applications of radioactivity, age of minerals and rocks, age of earth and solar system, medical, industrial and agricultural applications of radiochemistry, positron emission tomography, radioimmune assay. [5L]	15L
Standard References: Unit I& II 1. West A.R., Solid State Chemistry and its Applications, John Wiley and Sons (Asia) Pvt. Ltd. 2. Smart L.F., Moore F.A., Solid State Chemistry- An Introduction, 3 rd Edition, Taylor and Francis, 2005 3. Smith W.F., Principles of Material Science and Engineering, 3 rd edition, McGraw-Hill Inc. 1996		



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4. Keer H.V., Principles of the Solid State, first reprint, Wiley Eastern Limited, 1994
5. Principles of Material Science and Engineering, 3rd Edition, McGraw-Hill Inc. 1996

Unit III

6. Atkins P.W., Physical Chemistry, Oxford University Press, 6th Edition, 1998
7. McQuarrie D.A., Simon J.D., Physical Chemistry: A Molecular Approach, (1998) Viva Books, New Delhi

Unit IV

8. Friedlander G., Kennedy J.W., Nuclear and Radio Chemistry, 3rd Edition, John Wiley and Sons, 1981
9. Arnikaar H.J., Essentials of Nuclear Chemistry, 2nd Edition, Wiley Eastern Ltd. 1989

Additional References:

10. Raghavan V., Materials Science and Engineering, 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004
11. William D., Callister Jr., Materials Science and Engineering: An Introduction, 5th Edition, John Wiley and Sons (Asia) Pvt. Ltd. 2001
12. Pillai S.O., Solid State Physics, 5th Edition, New Age International Publishers, 2002
13. Leonid V., Azaroff, Introduction to Solids, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1977
14. Dann S.E., Reactions and Characterization of Solids, Royal Society of Chemistry, 2000
15. Rao C.N.R., Gopalakrishnan J., New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 1997
16. Hannay N.B., Solid State Chemistry, Prentice Hall of India, New Delhi, 1976.
17. AliOmer M., Elementary Solid State Physics, 5th Indian Reprint, Pearson Education Inc., 1999

Evaluation Scheme

- **Continuous Assessment (CA) – 40 Marks**
 - Knowledge and Application based: Objective test of 20 Marks
 - Skill based (20 marks): Learner will be assessed on relevant skills pertaining to the course content of a particular paper which could involve but not limited to
 - Oral Presentations on relevant topics
 - Review writing/Worksheets etc.
- **Semester End Examination (SEE)- 60 Marks**




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"A" Road, Churchgate, Mumbai - 400 020, India.

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Program: M.Sc. Chemistry

(Inorganic)

Course: Literature Review

Semester III

**Credit Based Semester and Grading System (CBSGS) with effect from
the academic year 2022-23**



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M.Sc. Literature Review Syllabus

Semester III			
Course Code	Course Title	Credits	Lectures/Week
PSCHEP2304	Literature Review	02	02



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Semester III – Practical

Course: PSCHEP2304	Literature Review (Credits: 02, Practical /Week: 02)
	Objectives: To understanding of the existing research and debates relevant to a particular topic or area of study, and to present that knowledge in the form of a written report. Outcomes: To critically write review and conclude its finding.
PSCHEP2304: Literature Review Literature survey, review writing and presentation	

Evaluation Scheme

- Semester End Examination (SEE)- 50 Marks




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