



**Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore**  
**Shri Vaishnav Institute of Science**  
**Name of Program: B.Sc. (Major: Chemistry)**  
**(2022-2025)**

**Semester V**

COURSE CODE	CATEG ORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
<b>BSCCH501</b>	<b>Core</b>	<b>Inorganic Chemistry II</b>	60	20	20	30	20	4	0	4	6

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit.

\***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.


**Course Educational Objectives (CEOs):**


The subject aims to provide the students:


1. To understand the chemistry of elements present in the first, second and third transition series.
2. To discuss various types of organometallic compounds and to acquire required knowledge of bioinorganic chemistry.
3. To include the importance of different types of theories and concepts of hard and soft acids and bases.
4. To understand different properties and reactions of the compounds of lanthanoids and actinoids.
5. To acquaint the students with practical knowledge of the concepts of inorganic chemistry.

**Course Outcomes (COs):**

1. Students will gain the basic knowledge of the first, second and third transition series elements.
2. They are able to understand various types of organometallic and bioinorganic compounds and their chemistry.
3. Students will be able to explain the fundamental concepts of hard and soft acids and bases.
4. They will be able to understand the properties of lanthanoids and actinoids and their compounds.
5. They can predict potential applications of inorganic chemistry and practical utility to become good chemist.

  
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**Syllabus**

**Unit-1**

**(A) Chemistry of elements of first transition series**

General characteristics of transition elements; Properties of the elements of the first transition series; Binary compounds; Main oxides of the elements of the first transition series – titanium oxide, vanadium oxide, vanadium oxide, iron oxides, zinc oxide; Carbides of the elements of first transition series; Complex formed by the elements of the first transition series – potassium permanganate, potassium hexacyanoferrate (II), sodium nitroprusside, bis (dimethyl glyoximato) nickel (II).


**(B) Chemistry of elements of second and third transition series**


General properties of elements of second and third transition series: ionic radii, oxidation state, magnetic properties (thermal energy and magnetic moment, Curie's equation, measurement of magnetic susceptibility by Gouy's method), spectral properties and stereochemistry.


**Unit-2**

**Organometallic Compounds**

Definition and classification of organometallic compounds; Hapticity of organometallic compounds;

  
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Metal carbonyls: 18 electron rule, structure, bonding, methods of preparation and properties of metal carbonyls; Zeise's salt: Structure, bonding, synthesis and reactions; Ferrocene: Structure, bonding, synthesis and reactions.

**Unit-3**

**Bioinorganic Chemistry**

Geochemical effects on the distribution of elements; Classification of chemical elements essential to life processes; Mechanism and functions of Sodium – Potassium Pump.


Biochemistry of Iron: Ferritin, Hemoglobin, Myoglobin.


Biochemistry of Calcium: Role of calcium in development of bone and teeth, Role of calcium in clotting of blood. Classification of Metallobiomolecules; Toxicity of metal ions (Hg, Pb, Cd and As); Cisplatin as an anti-cancer drug.


**Unit –4**

**Hard and Soft Acids and Bases (HSAB)**

Acid-Base Theories: Arrhenius concept; Bronsted and Lowry concept; Lux flood concept; Lewis concept.

  
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HSAB: Classification of acids and bases as hard and soft; Theoretical bases of hardness and softness; Pearson's HSAB concept; Acid – Base strength and hardness and softness; Application and limitations of HSAB principle.

**Unit –5**

**Lanthanoids and actinoids:**


General properties of lanthanides and actinides: electronic configuration, oxidation states, ionic radii, complex formation.


Lanthanide contraction: causes and effects of lanthanide contraction; Extraction of lanthanides from monazite minerals; Separation of lanthanides: Ion exchange method, solvent extraction method.


Chemistry of separation of Np, Pu and Am from U; Similarities between the post actinides and post lanthanides.

**References:**

1. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K., Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education.
2. Lee, J.D. Concise Inorganic Chemistry, ELBS.

  
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3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A., Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.


4. Cotton, F.A.; Wilkinson, G., Advanced Inorganic Chemistry Wiley-VCH.


5. Sodhi, G.S., Principles of Inorganic Chemistry, Viva books.


6. Garg, R., Singh, R., Inorganic Chemistry, McGraw Hill Education.

**List of Experiments:**

1. To determine the strength of ferrous ammonium sulphate (Mohr's salt) solution by using external indicator (Oxidation – Reduction Titration).
2. To determine the strength of potassium permanganate solution by using sodium thiosulphate solution Iodometrically.
3. To identify the cationic and anionic radicals present in given inorganic mixture (I) by performing various tests. (Salt Analysis)
4. To identify the cationic and anionic radicals present in given inorganic mixture (II) by performing various tests. (Salt Analysis)
5. To identify the cationic and anionic radicals present in given inorganic mixture (III) by performing various tests. (Salt Analysis)
6. To identify the cationic and anionic radicals present in given inorganic mixture (IV) by performing various tests. (Salt Analysis)
7. To identify the cationic and anionic radicals present in given inorganic mixture (V) by performing various tests. (Salt Analysis)
8. Inorganic Preparations. (Compound 1)

  
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9. Inorganic Preparations. (Compound 2)
10. Inorganic Preparations. (Compound 3)
11. Determination of acetic acid in commercial vinegar using NaOH.
12. Determination of alkali content - antacid tablet using HCl.
13. Estimation of calcium content in chalk as calcium oxalate by permanganometry.

  
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**Course Objectives: -**


1. The course will cover the applications of green chemistry principles to chemical industries with special emphasis on environmental concerns.
2. It has become imperative to devise safer alternative materials and technology that would ensure human sustenance.
3. This course intends to take the students through newer, environmentally friendly products and procedures and incite them to take a more holistic view of different chemical processes.
4. To give basic knowledge of microwave and ultrasound mediated organic synthesis.


**Course Outcomes: -**

After completion of this course the students are expected to be able to demonstrate the following knowledge, skills and attitudes. The student will demonstrate capability of the following,

1. Be able to rationalize the importance of developing safer alternative materials and technology that would ensure human sustenance. To impart knowledge on various green chemistry methods.
2. Understand benefits of use of catalyst and bio catalyst, use of renewable feed stock which helps in energy efficiency and protection of the environment, renewable energy sources, importance led reactions in various green solvents.

  
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3. Understand stoichiometric calculations and relate them to green chemistry metrics. They will learn about atom economy and how it is different from percentage yield.

4. The importance of practical knowledge and understanding of various industrial processes. To develop the standard experimental procedure of using ionic liquids.


### Syllabus


#### Unit I: Introduction to Green Chemistry


What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations / Obstacles in the pursuit of the goals of Green Chemistry. Principles of Green Chemistry with their explanations and examples, designing a Green Synthesis using these principles.

#### Unit II: Principles of Green Chemistry and Designing a Chemical synthesis

Prevention of Waste / byproducts in chemical process, maximum incorporation of the materials used in the process into the final products (Atom Economy), prevention / minimization of hazardous/toxic products, designing safer chemicals – different basic approaches, selection of appropriate auxiliary substances (solvents, separation agents),

  
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green solvents, solventless process, immobilized solvents and ionic liquids. Energy requirements for reactions - use of microwaves, ultrasonic energy, selection of starting materials, avoidance of solvents and toxic chemicals.

**Unit III: Examples of Green Synthesis/Reactions**


Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, aromatic amines (4- aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to strecker synthesis), citral, ibuprofen, paracetamol.


Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n-phenyl benzamide, methylbenzoate to benzoic acid), Oxidation (of toluene, alcohols). Microwave assisted reactions in organic solvents: Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels Alder Reaction, and Decarboxylation.


**Unit IV: Ultrasound assisted reactions**

Esterification, saponification, substitution reactions, Alkylations, oxidation, reduction, coupling reaction, Cannizzaro reaction, Selective methylation of active methylene group using dimethyl carbonate: Solid-state polymerization of amorphous polymers using diphenyl carbonate, Bio-catalysis in organic synthesis.

**Unit V: Future trends in green chemistry**

  
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Oxidation reagents and catalysts, Biomimetic, multifunctional reagents, combinatorial green chemistry, green chemistry for sustainable development.

**References:**

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers(2005).
2. P.T. Anastes & J.K. Warner: Oxford Green Chemistry- Theory and Practical, UniversityPress (1998).
3. A.S. Matlack: Introduction to Green Chemistry, Marcel Deckkar (2001).
4. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American ChemicalSociety, Washington (2000).
5. M.A. Ryan & M. Tinneland, Introduction to Green Chemistry, American ChemicalSociety, Washington (2002).

  
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**List of Experiments:**

1. ELECTROPHILIC AROMATIC SUBSTITUTION REACTION-II (Bromination of acetanilide)
2. GREEN PHOTOCHEMICAL REACTION (Photoreduction of Benzophenone to Benzopinacol)
3. PINACOL-PINACOLONE REARRANGEMENT REACTION-I (Preparation of Benzopinacolone)
4. RADICAL COUPLING REACTION (Preparation of 1, 1-Bis-2-Naphthol)
5. THREE COMPONENT COUPLING (Synthesis of Dihydropyrimidinone)
6. TRANSESTERIFICATION REACTION (Synthesis of Biodiesel)
7. PREPARATION OF MANGANESE(III) ACETYLACETONATE,  $Mn(acac)_3$
8. QUALITATIVE INORGANIC ANALYSIS with GREEN SOLVENTS, NON-TOXIC CHEMICALS
9. ACETYLATION OF PRIMARY AMINE (Preparation of acetanilide)
10. SOLVENT FREE, MICROWAVE ASSISTED ONE POT SYNTHESIS OF AMINO ACID (GLYCINE, VALINE) COMPLEX OF COPPER(II).

  
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BSCCH502B	DSE	Pharmaceutica ls Chemistry	3	0	2	4	60	20	20	30	20

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**COURSE OBJECTIVES:**

1. To give basic knowledge about pharmaceutical industries and pharmacopoeias.
2. To develop the understanding of fundamentals of Drugs packaging and dosages.
3. To understand the significance of pharmaceutical excipients.
4. To enable students to analyze the samples of crude drugs.
5. To get knowledge about quality standards of drugs.

**COURSE OUTCOMES:**


After completion of this course the students are expected to demonstrate the following skills, knowledge, and attitudes. Student will be able to understand:


1. Theoretical understanding of concept of pharmaceutical industry and pharmacopoeias.
2. The graduates will become familiar with fundamentals of Drugs packaging and dosages.
3. Students will be able to understand the significance of pharmaceutical excipients.
4. The students will be able to understand the quality standards of crude and manufactured drugs.


**SYLLABUS:**

**Unit- I**

Historical background and development of pharmaceutical industry in India, Important aspects of pharmaceutical chemistry. Introduction to pharmacopoeias. Material safety data

  
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sheet (MSDS), hazard labels of chemicals and personal protection equipment (PPE).


**Unit-II**


Introduction to Different dosage forms: Classification as per Routes of administration, physical state (solid, liquid, semisolids, and inhalations). Environmental control in Pharmaceutical Industry (Air, Water, Humidity and Temperature) Packaging materials: Containers and Closures, Types of Glass.

**Unit-III**

Various types of pharmaceutical excipients, their chemistry, process of manufacturing and quality specifications – Glidants, Lubricants, Diluents, Preservatives, Antioxidants, Emulsifying agents, Coating agents, Binders, Coloring agents, Flavoring agents, Gelatin and other additives.

  
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**Unit-IV**


Evaluation of crude drugs – moisture contents, extractive value, volatile oil content, foreign organic matter. Quantitative microscopic exercises including starch, crude fiber content. Various isolation procedures for active ingredients.


**Unit-V**


Quality control of Drugs and pharmaceuticals-Importance of quality control, significant errors, methods used for quality control, sources of impurities in pharmaceuticals. Limit tests for Arsenic, Chloride, Sulphate, Iron and Heavy metals.

**List of Practical's:**

1. Determination of percentage of moisture content of given drug sample.
2. Determination of acid value and Saponification value of given drug sample.
3. To determine the extractive value (water soluble) of crude drug.
4. Characterization of a drug sample using thin layer chromatography
5. To perform the limit test for chloride in the given sample of sodium bicarbonate.
6. To perform the limit test for sulphates in the given sample of sodium dihydrogen phosphate dihydrate.
7. To perform the limit test for heavy metals in the given sample.
8. To prepare and standardize 200 ml of 0.1 M silver nitrate solution.
9. Determination of Iodine value of given drug sample.

  
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							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BSCCH502B	DSE	Pharmaceutic als Chemistry	3	0	2	4	60	20	20	30	20

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;

\***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.


10. Write a report on “Material safety data Sheet (MSDS) of India; Important Aspects and Relevance”.


**Text Books:**


1. “Textbook of Pharmaceutical Chemistry-I (Inorganic)” by Mohammed Ali
2. “Pharmaceutical Chemistry-1” by Dr Kasture Dr Wadodkar
3. “Practical Pharmaceutical Chemistry: v. 2” by A H Beckett
4. “Medicinal and Pharmaceutical Chemistry” by V K Kapoor & Harkishan Singh
5. “Concise Organic Pharmaceutical Chemistry” by Deshmukh and Kuchekar

**Reference Books:**

1. Pharmacopoeia of India, Ministry of Health, Govt. of India.
2. Skoog D.A., Holler F.J., Crouch S. R., Instrumental Analysis, Indian Edition, Brooks/Cole, Boston.
3. Willard H.H., Merrit L.L., Dean J.A., Settle P.A., Instrumental Methods of analysis, CBS Publishers and Distributors New Delhi.
4. Becket A.H. and Stenlake J.B., Practical Pharmaceutical Chemistry Vol. I and II, The Athlone Press of the University of London.
5. Pavia D.L., Lampman G.M. and Kriz G.S., Introduction to Spectroscopy, Harcourt College Publishers, Philadelphia.
6. Chatten L.G., A Text Book of Pharmaceutical Chemistry, Vol. I and II, Marcel Dekker, New York.

  
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