# Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
## Shri Vaishnav Institute of Science
## Department of Chemistry
## Name of Program: M.Sc. (Chemistry) (CBCS) (2021-2023)

| COURSE CODE | CATEGORY | COURSE NAME | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME | | | | |
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| | | | | | | | THEORY | | PRACTICAL | | |
| | | | | | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| MSCH401 | PG | Principles of Bioinorganic Chemistry | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

**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 OBJECTIVES:

1. To give basic knowledge of concept of Principles of Bioinorganic Chemistry.
2. To develop the understanding of Role of alkali and alkaline earth metal ions in biology.
3. Enable students to apply the concepts of Electron Transfer.
4. The purpose of the course is to make the students to understand the concepts and practical applications of Principles of Bioinorganic Chemistry.

### 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 Principles of Bioinorganic Chemistry.
2. Became aware of the Role of alkali and alkaline earth metal ions in biology.
3. Students will be able to understand the concept of Electron Transfer.
4. The students will be able to understand the practical applications of Principles of Bioinorganic Chemistry.

### SYLLABUS:

**UNIT I**

Role of alkali and alkaline earth metal ions in biology; Na+-K+ Pump, ionophores and crown ethers. Metal site structure, function. General survey of essential and trace metals, Disturbing factors in metabolic process and causes of diseases, different classes of drugs

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| MSCH401 | PG | Principles of Bioinorganic Chemistry | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

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

Metal ion transport and storage: Ferritin, Transferrin, Siderophores and metallothionein. Ionophores, active transport of cations across membranes, sodium pump, Calcium pump, Calcium carriers, role of carriers in muscle contraction, blood clotting and hormones.

### UNIT III

Electron Transfer: Cytochromes, Iron-Sulfur Proteins and Copper Proteins. Oxygen transport and storage: Hemoglobin, myoglobin, hemerythrin, hemocyanin Oxygen activation: Cytochrome P450, Cytochrome c oxidase, Nitrogen fixation.

### UNIT IV

Other metal containing enzymes: Catalase, peroxidase, superoxide dismutase, alcohol dehydrogenase, carbonic anhydrase, carboxypeptidase, xanthine oxidase, nitrogenase, vitamin B12 coenzyme, photosystem I and II, oxygen evolving center. Various spectroscopic methods used in bioinorganic chemistry: electronic spectra, EPR (emphasis on first row transition metal ions and their spectra), brief description of CD / MCD and multinuclear NMR.

### UNIT V

Applications of newer methods like EXAFS, XANES and ENDOR in characterization of biological molecules. Use of coordination complexes as models for various enzymes, metalloproteins. Role of hazardous materials such as nitric oxide, cyanide and methyl isocyanate etc. in biological systems.

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**Text Books:**

1. S. J. Lippard and J. M. Berg, Principle of Bioinorganic Chemistry, University Science Books (1994).
2. Lawrence Que, Jr, Physical Methods in Bioinorganic Chemistry: Spectroscopy and Magnetism, University Science Books (2000).

**Reference Books:**

1. F. A. Cotton and G. W. Wilkinson, Advanced Inorganic Chemistry, 5th Ed., John-Wiley & Sons, (1988).
2. D. Banerjea, Coordination Chemistry, 2nd Ed, Asian Books Pvt. Ltd. (2007).
3. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4th Ed. Harper Collins (1993).

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| MSCH402 | PG | Photochemistry and Organic synthesis | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

**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 OBJECTIVES:

1. To give basic knowledge of concept of Photochemistry
2. To develop the understanding of Organic synthesis.
3. Enable students to apply the concepts of Reaction mechanism.
4. The purpose of the course is to make the students to understand the concepts and practical applications of Photochemistry and Organic synthesis

### 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 Photochemistry
2. Became aware of Organic synthesis.
3. Students will be able to apply the concepts of Reaction mechanism.
4. The students will be able to understand the practical applications of Photochemistry and Organic synthesis.

### SYLLABUS:

**Unit I: Photochemistry – general principle and applications**

Principles of photochemistry: quantum yield, electronic states and transitions, selection rules, modes of dissipation of energy (Jablonski diagram), electronic energy transfer: photosensitization and quenching process.

Interaction of radiation with matter, types of excitations, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, singlet, and triplet states. Photochemistry of carbonyl compounds: $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions, NorrishI and Norrish-II cleavages, Paterno-Buchi reaction.

Photochemistry of enones, photochemical rearrangements of α, β-unsaturated ketones and cyclohexadienones. Photo Fries rearrangement, Barton reaction.

Photochemistry of olefins: cis-trans isomerizations, dimerizations, hydrogen abstraction, addition and Di- π- methane rearrangement including aza-di- π -methane.

Photochemical Cross-Coupling of Alkenes, Photodimerisation of alkenes.

Photochemistry of arenes: 1, 2- , 1, 3- and 1, 4- additions. Photocycloadditions of aromatic

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| MSCH402 | PG | Photochemistry and Organic synthesis | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

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**Unit II: Pericyclic Reactions – types, PMO and FMO approach**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Perturbation of Molecular Orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions. Electrocyclic reactions, conrotatary and disrotatary motion 4n and (4n+2) systems, Cycloaddition reaction with more emphasis on [2+2] and [4+2], Cycloaddition of ketones Secondary effects in [4+2] cycloaddition. Stereochemical effects and effects of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolar cycloaddition and chelotropic reaction.

**Unit III: Oxidation – Introduction and different Oxidative Processes**

Oxidation of alkenes: Alkenes to epoxides: Peroxide induced epoxidation-epoxidation by H2O2, hydroperoxides and peroxyacids. Alkenes to diols: oxidation by potassium permanganate, Osmium tetraoxide and its stereochemical consideration, Prevost oxidation and Woodward modifications.
Oxidation of Alcohols: Alcohols to carbonyl compounds: Chromium (VI) oxidants, Dimethyl sulfoxide and its modifications (Swern Oxidation), Mangnese (IV) oxide, Silver carbonate, Hypervalent iodine (III) and (V) reagents cerric ammonium nitrate (CAN).
Oxidative cleavge of 1,2-diols: Periodic acid.
Oxidation of allylic and benzylic C-H bonds: NBS, DDQ, Chloranil T, SeO2.
Oxidation of aldehydes and ketones, Conversion of ketones to α, β-unsaturated ketones and α-hydroxy ketones, Baeyer-Villiger oxidation, Chemistry and synthetic applications of Pb(OAc)4, Dess-Martin periiodinane, IBX.

**Unit IV: Reduction reactions – Introduction and different Reductive Processes**

a) Reduction: Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of

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alkenes, alkynes and arenes, Selectivity of reduction, Mechanism and stereochemistry of reduction, Raney Ni-catalyst, Adam catalyst, Lindlar catalyst, Wilkinson catalyst.
b) Reduction by dissolving metals, Reduction of carbonyl compounds, conjugated systems, aromatic compounds, and alkynes. Birch reduction and Hydrogenolysis of selected organic compounds.
c) Reduction by hydride transfer reagents, Meerwein-Pondorff-Verley reduction, Reduction with $LiAlH_4$ and $NaBH_4$, stereochemical aspects of hydride addition,

**Unit V: Preparation and synthetic application of P, S, and Si compounds**

a) Phosphorus and sulphur ylide: Preparation and their synthetic application along with stereochemistry.
b) Umpolung concept: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, ethylmethylthiomethylsulphoxide, bis-phenylthiomethane, metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion, thiamine hydrochloride-based generation of acyl anion.

**Textbooks:**

1. Books as suggested in Semester I for organic chemistry
2. Organic Synthesis, The disconnection approach-S. Warren
3. Designing Organic Synthesis-S. Warren
4. Some Modern Methods of Organic Synthesis-W. Carruthers

**Reference Books:**

1. Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
2. Protective Group in Organic Synthesis-T. W. Greene and PGM
3. The Chemistry of Organo Phosphorous-A. J. Kirbi and S.G. Warren

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| MSCH403(A) | PG | Environmental Chemistry | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

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

1. To give basic knowledge of the concept of Environmental Chemistry.
2. To develop an understanding of Pollution Control Techniques.
3. Enable students to apply the concepts of treatment of water, air, & soil.
4. The purpose of the course is to make the students understand the concepts and practical applications of Environmental Chemistry.

### 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 Environmental Chemistry.
2. Students will be able to understand Pollution Control Techniques.
3. Students will be able to apply the concepts of treatment of water, air, & soil.
4. The students will be able to understand the practical applications of Environmental Chemistry

### Syllabus:

### UNIT I

Atmospheric composition and principles of contaminant behavior
The atmosphere of Earth; Contaminant behavior in the environment; Greenhouse effect - Global temperature-Acid rain and - Ozone layer depletion

Contaminants and their natural pathways of degradation and their abatement
Carbon Cycle; Nitrogen Cycle; Sulphur Cycle; $CO_2$ formation in atmosphere; Organic Pollutants; Pollution from Combustion Systems; Coal Combustion; Photochemical Smog

### UNIT II

Air Pollution Control Techniques, Carbon dioxide; Oxides of nitrogen; Sulphur Dioxide; Volatile Organic Compounds; Instruments techniques to monitor pollution. Methods to control air pollution in the environment, Limestone injection and fluidized bed combustion, Desulfurization; Catalytic converter and control of vehicular emission, Gravity settling chamber, Centrifugal collectors-cyclone collector, and dynamic precipitators; Electrostatic precipitators;

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Fabric filters.

**UNIT III**

Ground and subsurface water contamination; Water pollution sources; Ground Water Pollution; Ocean Pollution. Eutrophication; Acid Mine Drains; Pesticides and Fertilizers; Dying and Tanning

Sewage and waste water treatments systems; Primary, secondary and tertiary treatments; Measurement of treatment efficiencies; Biological treatments - aerobic versus anaerobic treatments; Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Bioreactors for waste water treatments; Reactors types and design; Reactors in series; Development and optimization of membrane bioreactor process for use in sanitary and industrial sewage treatment.

**UNIT IV**

Soil Water Characteristics; Soil Erosion; Soil & Pollution; Water resources: Irrigation and Wetlands, Solid waste management, Solid waste disposal methods - open dumps, ocean dumping, Landfills, Incineration; Recycling and reuse. Organic pollutants and Hazardous waste disposal and management.

Toxic, and Hazardous waste management: Management of Radiation, noise, thermal, oil and e-wastes: recycling of waste. Biosorption - Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills; Hydrocarbon degradation

**UNIT V**

Bioremediation, Biotransformation Biodegradation and Phytoremediation: In situ and Ex situ bioremediation; Evaluating Bioremediation; Bioremediation of VOCs. Factors affecting process of biodegradation; Methods in determining biodegradability; Contaminant availability for biodegradation.; Use of microbes (bacteria and fungi) and plants in biodegradation and Biotransformation; Phytoremediation: Wastewater treatment using aquatic plants; Root zone treatment.

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**Text Books:**


1. Manahan, Stanley E. Fundamentals of Environmental Chemistry Boca Raton: CRC Press LLC,2001.
2. Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L. Strong Chemistry of the Environment, Elsevier Science &Technology Books 2002.
3. Eugene R. Weiner Applications of Environmental Chemistry 2000 CRC Press, LLC.
4. By Clair N. Sawyer, Perry L. McCarty, Gene F. Parkin Chemistry for environmental engineering and science (5th edition) McGraw Hill Professional.


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| MSCH403(B) | PG | Surfactants and Macromolecules | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

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

1. To give basic knowledge of concept of Surface Chemistry and its significance
2. To develop the understanding of Bio-surfactants and drug delivery systems.
3. Enable students to apply the concepts of Surface tension and its determination.
4. The purpose of the course is to make the students to understand the concepts and practical applications of Surfactants and Macromolecules

### 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 Surface Chemistry and its significance
2. Became aware of the Bio-surfactants and drug delivery systems.
3. Students will be able to apply the concepts of Surface tension and its determination.
4. The students will be able to understand the practical applications of Surfactants and Macromolecules.

### SYLLABUS:

**UNIT I**

Surface tension and its determination, thermodynamics of liquid interface, surface energy and free energy of liquids, Adhesion and cohesion, surface tension of solution. Binary systems: Gibbs equation.
Monomolecular films: Gibbs monolayer, Traube's rule. Langmuir Blodgett films. Spreading.

**UNIT II**

Block co-polymers: Pluronics, Clouding phenomenon and effect of additives. Clouding in ionic surfactant solutions: Cloud point extraction methodologies, mechanism and variation. Bio-surfactants and drug delivery systems. Surfactant polymer interactions, phase behaviour, PIT and HLB.

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| MSCH403(B) | PG | Surfactants and Macromolecules | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

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**UNIT III**

Enzymes (continued) Enzyme mechanisms, Nucleic acids, Lipids and Membranes, Vitamins and Coenzymes, Carbohydrates, Bioenergetics Metabolism.

**UNIT IV**

Insoluble spread monolayer. Surface pressure, potential and viscosity. Uses of monolayer. Forces : long and short range, contact angle, Young's equation, wetting,. Adsorption of nonelectrolytes. Langmuir (statistical Thermodynamical) and BET equation. Adsorption of electrolytes. Lubrication and foams. Emulsions. HLB number. The ageing and inversion of emulsions. Ellipsometry.

**UNIT V**

Recapitulations, morphologies, aggregation number and its determination (SANS and DLS), Kinetics in Micellar media, reverse micellar solutions and their applications, Physico-chemical characterization of micro-emulsions, interfacial compositions.

**Text Books:**


1. Non-ionic surfactants by M. J. Schick, Surfactant Science Series, (1985)
2. Colloids and Interface Science by P. Ghosh, PHI learning Pvt. Ltd. New Delhi (2009).
3. Surfactants and Interfacial Phenomena by M. J. Rosen, John Wiley, New Jersey (2004).
4. Handbook of surfactants, M. R. Porter, Chapman and Hall, London (1994).
5. The Hydrophobic Effect by C. Tanford, John Wiley, New York (1980).
6. Physical Chemistry of Surface, A.W. Adamson, John Wiley (1976).
7. Physics and Chemistry of Surfaces , J. Oudar, Blackie & Sons (1975)


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| MSCH403(C) | PG | Industrial Chemistry | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

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

1. To give basic knowledge of concept of Industrial Chemistry.
2. To develop the understanding of fundamentals of Industrial Catalytic Processes.
3. Enable students to apply the concepts of Fundamentals of Microbiology & Biochemistry.
4. The purpose of the course is to make the students to understand the concepts and practical applications of Industrial Chemistry

### 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 Industrial Chemistry.
2. The graduates will become familiar with fundamentals of Industrial Catalytic Processes.
3. Students will be able to apply the concepts of Fundamentals of Microbiology & Biochemistry.
4. The students will be able to understand the practical applications of Industrial Chemistry.

### SYLLABUS:

### UNIT I

Polymers in fiber industry: Fiber forming polymers. Synthesis, structure and properties of fibers. Application of fibers. Polymers for paints and coatings: Basics of paint technology. Polymeric binders, pigments, extenders, and additives. Essential concepts of paint formulations. Properties of paints. Polymers as adhesives: Polymer based adhesives. Adhesion improvers. Thermal and mechanical behavior of adhesives. Mechanism of adhesion.

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# Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
## Shri Vaishnav Institute of Science
## Department of Chemistry
## Name of Program: M.Sc. (Chemistry) (CBCS) (2021-2023)

| COURSE CODE | CATEGORY | COURSE NAME | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | THEORY | | PRACTICAL | | |
| | | | | | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| MSCH403(C) | PG | Industrial Chemistry | 4 | 0 | 0 | 4 | 60 | 20 | 20 | 00 | 00 |

**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.

**UNIT II**

Electronic polymers: Polymers used in electronic industries. Physical, chemical, and morphological properties of electronic polymers and their applications. Piezo and pyroelectric polymers. Electric and dielectric properties of polymers.

Polymers in information technology: Polymers in optical media data storage devices. Various types of polymers used in information technology, their synthesis, and properties. Fabrication of CD substrates. Polymers in tyre industries.

**UNIT III**

Industrial Catalytic Processes, Basic concepts in phase transfer catalysis – phase transfer catalyzed reactions – basic steps of phase transfer catalysis – effect of reaction variables on transfer and intrinsic rates – outline of compounds used as phase transfer catalysts. Petroleum-Petro-chemistry; catalytic reforming; catalytic cracking; paraffin cracking; naphthenic cracking; aromatic hydrocarbon cracking; isomerization; hydrotreatment; hydrodesulphurization; hydrocracking; steam cracking; hydrocarbons from synthesis gas

**UNIT IV**

Chemistry of Electronic Ceramics: Properties of ceramic insulators, Ceramic capacitor materials, Piezoelectric and electro-optic ceramics, Ferrite (magnetic) ceramics, Ceramic sensors,

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Application, and characterization of ZnO varistors, Highly Conductive Ceramics, Materials aspects of thick film technology, Multilayer Ceramic technology.

**UNIT V**

Fundamentals of Microbiology & Biochemistry Isolation, identification, and preservation of industrial microorganisms; Physiology and morphology of bacteria, yeast and fungi; Characteristics of viruses; Bioenergetics of metabolic pathways; Elementary mass balance; Energy balance; ATP generation and YATP, Energy yielding and consuming metabolic pathway; Detoxification of Xenobiotic compound; Steroid transformation.

**Text Books:**


1. Rao, A.S. (1997). **Introduction to Microbiology**. Prentice-Hall of India Pvt Ltd., Nerw Delhi.
2. Black, J.G. (2005). **Microbiology: Principles and Explorations**, John Wiley, USA.
3. Voet, D. and Voet, J.G. (1995) **Biochemistry**, Wiley, New York.
4. Zubay, G. (1998). **Biochemistry** WCB. Mc GrawHill, Iowa.
5. F.H Norton (2001) Elements of Ceramics, Mc GrawHill.
6. Barsoum (1999) Fundamentals of Ceramics, John Wiley, USA.


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