Shri Vaishnav Vidyapeeth Vishwavidyalaya

M.Sc. (Chemistry)

Choice Based Credit System (CBCS)(Batch 2019-2021)

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*
MSCHE 401	PG	Principles of Bioinorganic Chemistry	4	0	4	6	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.

Course Objectives:

1. To give basic knowledge of concept of bioinorganic chemistry.
2. To develop the understanding of bioinorganic chemistry.

Course Outcomes:

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

CO1. Theoretical understanding of concept concept of bioinorganic chemistry

CO2. Became aware 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 tracemetals, Disturbing factors in metabolic process and causes of diseases, different classes of drugs

UNIT II

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

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.

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.

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).

List of Practical's: (If Practical Credit Shown in Syllabus)

Guidelines for Practical:

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							THEORY		PRACTICAL		
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MSCHE 402	PG	Concepts in Organic Synthesis	4	0	4	6	60	20	20	30	20

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Course Objectives:

1. To give basic knowledge of concept of Organic synthesis.
2. To develop the understanding of Organic synthesis.

Course Outcomes:

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

CO1. Theoretical understanding of concept concept of Organic synthesis

CO2. Became aware of Organic synthesis.

Syllabus:

UNIT I

Pericyclic Reactions: Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions.

UNIT II

Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reaction; conrotatory and disrotatory motions 4n, 4n+2 and allyl systems. Photochemistry: Quantum yields, intersystem crossing, photosensitization and energy transfer reactions. Photochemistry of olefins and carbonyl compounds, photo oxygenation and photo fragmentation, Photochemistry of aromatic compounds: isomerisation, additions and substitutions. Singlet molecular oxygen reactions. Patterno-Buchi reaction, Di-pimethane rearrangement, Bartons reaction and Photo-Fries rearrangement.

UNIT III

Cycloaddition; antrafacial and suprafacial addition, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Reagents in Organic Synthesis: Use of the following reagents in organic synthesis and functional group transformations; complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium diisopropylamide (LDA).

UNIT IV

Sigmatropic Rearrangements; suprafacial and antrafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements, Claisen, Cope and Aza-Cope rearrangements. Ene reaction.

UNIT V

Phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Baker yeast. Heterocyclic Chemistry: Synthesis and reactivity of furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline and indole; Skraup synthesis, Fisher indole synthesis.

Text Books:

1. Frontier Orbital and Organic Chemical Reactions by I. Fleming, John Wiley, 1976.
2. Some modern Methods of Organic Synthesis by W. Carruthers, Cambridge University Press,1990.
3. Protective Groups in Organic Synthesis by T.W. Greene, Wiley-VCH, 1999.

Reference Books:

1. Modern Heterocyclic Chemistry by L. A. Paquette, W.A. Benjamin, Inc.,1968.
2. Organic Chemistry by I. L. Finar, Vol II, ELBS, 1968.
3. Heterocyclic Chemistry by T. R. Gilchrist, Longman,1989.
4. Selectivity in Organic Synthesis by Ward, Wiley-VCH, 1999.

List of Practical's: (If Practical Credit Shown in Syllabus)

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							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSCHE 403	**PG**	**Photochemistry and Organic Reaction Mechanism**	**4**	**0**	**4**	**6**	**60**	**20**	**20**	**30**	**20**

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Course Objectives:

1. To enable the student to learn, understand mechanistic aspect of organic chemistry.
2. To develop the understanding of various organic synthesized process.

Course Outcomes:

1. Theoretical understanding of Organic concept.
2. Became aware of various organic mechanism.
3. Different type, choice of reagents for Oxidation and Reduction reactions.

Syllabus:

Unit I: Photochemistry – general principle and applications

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, Photochemistry of parabenzoquinones, photochemistry of Aromatic compounds with reference to isomerisation additon and substitution Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, di-pi methane rearrangement.

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 effect of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolar cycloaddition and chelotropic reaction.

Unit III: Oxidation reactions – types, applications of different reagents

Oxidation: Oxidation of alkanes, aromatic hydrocarbons and alkenes, Dehydrogenation with S, Se, Fremy's salt, DDQ, chloranil and $PhI(OAc)_2$, Oxidation with SeO_2, Epoxidation of olefins, Synthetic application of epoxides, Sharpless asymmetric epoxidation, Dihydroxylation of olefins using $KMnO_4$, OsO_4, Woodward and Prevost dihydroxylation, Oxidative cleavage of olefins, Ozonolysis a) Oxidation of alcohols: Chromium reagents, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collin and Jones reagent, Combination of DMSO with DCC, $(COCl)_2$, NCS and $(CH3CO)_2O$ for oxidation of alcohols, Oxidation with MnO_2, Oppenauer

oxidation b) 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 – types, applications of different reagents

a) Reduction: Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of 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, Derivatives of $LiAlH_4$ and $NaBH_4$, Selectivity issues, Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride, Reduction with boranes and derivatives Reduction with Bu_3SnH_4, Reduction of carbonyl group to methylene, Reduction with diimide and trialkylsilanes.

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

a) Phosphours and sulphur ylide: Preperation 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.

Text Books:

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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List of Practical's: (If Practical Credit Shown in Syllabus)

Guidelines for Practical:

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M.Sc. (Chemistry)

Choice Based Credit System (CBCS)(Batch 2019-2021)

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							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSCHE 404 (A)	PG	Environmental Chemistry	4	0	4	6	60	20	20	30	20

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*__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 Environmental Chemistry.
2. To develop the understanding of Environmental Chemistry.

Course Outcomes:

1. Theoretical understanding of concept concept of Environmental Chemistry
2. Became aware 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 formation in atmosphere; Organic Pollutants; Pollution from Combustion Systems; Coal Combustion; Photochemical Smog

UNIT II

Air Pollution Control Techniques, Carbon Monoxide; 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; 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: Waste water treatment using aquatic plants; Root zone treatment.

Text Books:

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

List of Practical's: (If Practical Credit Shown in Syllabus)

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M.Sc. (Chemistry)

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							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSCHE 404 (B)	PG	Organometallic Chemistry	4	0	4	6	60	20	20	30	20

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*__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 organomattalic Chemistry.
3. To develop the understanding of organomattalic Chemistry.

Course Outcomes:

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

CO1. Theoretical understanding of concept concept of organomattalic Chemistry

CO2. Became aware of organomattalic Chemistry.

Syllabus:

UNIT I

Definition, classifications and bonding in organometallic compounds. Isolobal analogies. Structural methods of Organometallics. Preparative methods. Spectroscopic techniques in Organometallic chemistry. Electronic and magnetic properties of Organometallic compounds.

UNIT II

Stoichiometric and catalytic reactions. Fundamental processes in reactions of organo-transition metal complexes. Applications of transition metal complexes to catalysis, organometallics directed towards organic synthesis.

UNIT III

Bio-organometallics, Organometallics in environmental chemistry. Metal clusters and models for heterogeneous catalysis. Application of Organometallics in Industry. Metallocenes.

UNIT IV

Metal carbonyl complexes, Metal carbonyls –Part II, Ligand substitution reactions, Substitutes for carbonyl ligands, Carbene complexes, Carbene complexes continued Non-Carbon Ancillary ligands Non-Carbon Ancillary ligands continued, Metal alkyl complexes, Ligand Insertion Reactions

UNIT V

Metal alkene complexes, Metal dihydrogen and hydrides, Migratory Insertion reaction with alkynes. Oxidative addition & Vaskas complex mechanism Reductive elimination Reductive Elimination mechanism Oxidative coupling with C-C bondformation, Metathesis reactions.

Text Books:

1. Organometallics: A Concise Introduction Authors: Christoph Elschen broich Year:2006.
2. Fundamentals of Organometallic Catalysis Author: Dirk SteinbornYear:2012Publisher:Wiley-VCHISBN:978-3-527-32717-1.
3. Basic Organometallic Chemistry: Concepts, Syntheses and Application Authors: BD Gupta & Anil J Elias Year:2013 Publisher: Universities PressISBN:978-81-7371-709-3.
4. Fundamentals of Organometallic Catalysis Author: Dirk SteinbornYear:2012 Publisher: Wiley-VCHISBN:978-3-527-32717-1.
5. Organometallic Chemistry and Catalysis Author: Didier Astruc Year: 2007 Publisher: Springer ISBN:978-3-540-46129-6.

List of Practical's: (If Practical Credit Shown in Syllabus)

Guidelines for Practical:

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M.Sc. (Chemistry)

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							THEORY		PRACTICAL		
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MSCHE404 (C)	PG	Industrial Chemistry	4	0	4	6	60	20	20	30	20

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*__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 Industrial Chemistry.
2. To develop the understanding of Industrial Chemistry.

Course Outcomes:

1. Theoretical understanding of concept concept of Industrial Chemistry
2. Became aware 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 behaviour of adhesives. Mechanism of adhesion.

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

Spectroscopic Methods: Ultraviolet Spectrophotometery (UV), Visible Spectro photometery, Infrared Spectrophotometery (IR), Nuclear Magnetic Resonance Spectroscopy (NMR) and

Electron Spin Resonance Spectroscopy(ESR), Flame Photometry, Atomic Absorption Spectroscopy(AAS), Induced Couple Plasma Spectroscopy (ICP), Atomic Fluorescence Spectroscopy.

UNIT IV

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