Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

B.Sc. (Chemistry) Honours

SEMESTER V

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*
BSHCH 502	DC	Green Chemistry	4	0	0	4	60	20	20	0	0

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A – Quiz/Assignment / Attendance, MST Mid Sem Test.

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

Course Objectives:-

The course will cover the applications of green chemistry principles to chemical industries with special emphasis on environmental concern. It has become imperative to devise safer alternative materials and technology that would ensure the human sustenance. This course intends to take the students through newer, environment friendly products and procedures and incite them to take a more holistic view of different chemical processes. 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 following knowledge, skills and attitudes. The student will demonstrate capability of the following,

CO1. Be able to rationalise the importance of developing safer alternative materials and technology that would ensure the human sustenance. To impart knowledge on various Green chemistry methods.

CO2. The importance of practical knowledge and understanding of various industrail processes. To develop the standard experimental procedure of using ionic liquids.

Course Outcomes:-

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), 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 benzole 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, Cannizaro reaction, Strecker synthesis, Reformatsky reaction. Selective methylation of active methylene group using dimethyl carbonate: Solid-state polymerization of amorphous polymers using diphenyl carbonate, Use of “Clayan”, a non- metallic oxidative reagent for various reactions, free radical Bromination, Role of Tellurium in Organic Syntheses, Bio-catalysis in organic synthesis.

Unit V: Future trends in Green chemistry

Oxidation reagents and catalysts, Biomimetic, multifunctional reagents, combinatorial green chemistry, Proliferation of solventless reactions on covalent deriatization, Green chemistry for sustainable development.

Suggested Readings:

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).

2. P.T. Anastes & J.K. Warmer: Oxford Green Chemistry- Theory and Practical, University Press (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 Chemical Society, Washington (2000).

5. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).

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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*
BSHCH 503	DC	Molecules of Life	4	0	0	4	60	20	20	0	0

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A – Quiz/Assignment / Attendance, MST Mid Sem Test.

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

Course Objectives:-

In this course the basics of Bioorganic and Bioinorganic chemistry, its inception and its today's platform will be focused. A multidisciplinary approach has been employed to provide the best leverage to students to enable them to learn the interface of chemistry and biology. Further this course will provide students, the role of organic molecules and metals in living organisms. This goes along with the elucidation of model systems and technical applications of both, concepts learned from nature as well as biological systems.

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 the following,

CO1. Be able to rationalise the importance of Molecular recognition, Asymmetric synthesis and application of Unnatural amino acids. To impart the knowledge on SNP, Antigene / Antisense therapy.

CO2. The importance of metal ions in biological processes, structure and functions of electron transfer proteins, enzymes, coenzymes and apoenzymes. To learn the applications of Nanoparticles in Biosciences and Medical applications of metal ions and its complexes.

Unit I: Introduction to Bioorganic Chemistry and Amino acids

Overview of Bioorganic Chemistry (from past to present), weak interactions in small and bio molecules, proximity effect in Organic chemistry, Molecular recognition, Chemistry of living cells, Analogy between Biochemical and Organic reactions. Amino acids and their Asymmetric synthesis, Chemistry of peptide bonds, Peptide secondary structures and tools for stabilization. Synthesis and application of Unnatural amino acids.

Unit II: Bioorganic Chemistry of Nucleic Acids

Introudction to Nucleic acids, components of nucleic acids – sugars and bases, structure of DNA, Conformation of sugar-phosphate back bone, hydrogen bonding by bases, structure and stability of double helix, structure and types of RNA, Synthesis and application of

Unnatural nucleosides, Single nucleotide polymorphism (SNP), Hap-Map project, Conepts of Antigene / Antisense therapy, Gaol for personalised medicine.

Unit III: Metal ions in Biological systems

Bioionorganic chemistry - General terms, how and why nature selects inorgtanic elements? Essnetial and trace metals, Na / K^+ pump, role of metal ions in biological processes. Structure and functions of electron transfer proteins. Respiratory chain and role of Cytochromes, Iron and Sulphur proteins: Rubredoxin and Ferridoxins. Photosynthesis and photosystem - I, II.

UNIT IV: Transport, Storage of Dioxygen and Enzymes

Heme proteins, structure and function of hemoglobin and myoglobin. Introduction of enzymes, enzyme action. Transition-state theory, oreintation and steric effect, examples of some enzyme mechanisms – chymotripsin, lysozyme. Coenzymes, prostehtic groups, apoenzymes, vitamin B12, NAD+, NADP+. Mechanisms of reactions catalysed by the above coenzymes.

UNIT V: Applications of Bioorganic and Bioinorganic chemistry

Biomineralization, nature and function of different bio-minearls and understand the mechanism of biomineralization. Nanoparticles and its applications in Biosciences, functions of non-redox active elements for Protien / DNA. Medical aaplications of Bioorganic chemistry, principles and mechanism of homeostasis of a cell, Medical applications of metal ions and complexes for the treatment of cancer, diabetes, arthritis.

References

1. Hermann Dugas, C Penny, Bioorganic Chemistry: A chemical approach to enzyme action, Springer – Verlag
2. AL Lehninger, Principles of Biochemistry, Worth Publishers
3. Collin J Suckling, Enzyme Chemistry: Impact and Applications, Chapman and Hall
4. L Stryer, Biochemistry, W.H. Freeman
5. F Wold, Macromolecules: Structure and Function, Prentice Hall
6. I Bertini, HB Gray, SJ Lippard, JS Valentine, Bioinorganic Chemsitry, University Science Books
7. Rekha Dashora, AK Goswami, Supramolecular and Bioinorganic Chemistry, Pragati Prakashan
8. NC Price, L Stevens, Fundamentals of Enzymology, Oxford University Press

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SEMESTER V

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*
BSHCH504	DC	Research Methodology for Chemist	4	0	0	4	60	20	20	0	0

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

Course Objectives:-

The course will cover the research process, data analysis to researcher with special emphasis on laboratory safety, errors, chromatographic analysis and spectral analysis that are used for chemistry research course.
To give basic knowledge of good lab practice, collection of data and interpretation of data.
To develop the writing skill of scientific articles and research proposal.

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 the following,
CO1. Be able to rationalise the importance of lab safety, systeatic way of analysing the data and this course on Research methodology for chemist will provide the understanding of chromatographic analysis and spectral analysis which is basic tool in industries.
CO2. The importance of following: literature survey, hypothesis, writing research proposal, presentation (oral and poster), scientific reports and understanding of thermal analysis.

UNIT I: Laboratory safety and Data analysis

General safety and operational rules, safety equipments, personal protective equipments, safety practices for disposal of broken glass wares. Emergency response, chemical spills, radiation spills, biohazard spills, leaking compressed gas cylinders, fires, medical emergency and accident reporting. Errors in chemical analysis, classification of errors, determination of accuracy of methods, improving the accuracy of analysis, significant figures, mean, standard deviation, comparison of results: “t” test, “f” test and “chi” square test, least squares analysis by use of advance softwares .

UNIT II: Research process and Literature survey

Basis of scientific research, formation of the research topic, hypothesis, conceptual definitions, operational definition, gathering of data, analysis of data, revising of hypothesis and Literature survey journals, books and e-resources. Presentation and publication of research output. General aspects of scientific writing, writing essays, reporting practical and project work, writing literature surveys, reviews organizing a poster display and giving an

oral presentation examinations. Research problem, meaning and sources of research problems, criteria / characteristics of a good research problem. Hypothesis, meaning and types of hypothesis. Research report, format and style of writing the report, references and bibliography.

Unit III: Chromatographic techniques

Gas chromatography: Theory of chromatography, column efficiency and column equation, sample injection, sampling system for capillary columns and packed columns, detectors, gas flow control system, high resolution gas chromatography/mass spectroscopy.

HPLC: Principles of high performance liquid chromatography, instrumentation, the requirements of solvent pumping and different pumping systems, gradient elution, isocratic elution, sampling, detectors for liquid chromatography, the mobile phase in HPLC, solvent degassing, column technology, column selection, quantitative analysis by HPLC. Brief introduction of UPLC and comparison it with HPLC.

Unit IV: UV-Visible, AAS, AES and Thermal methods of analysis

Analytical techniques for chemical research, optical methods of analysis, basic principles of UV -Visible, AAS, AES technique. Electro analytic methods, Principles and applications of polaro graphy, coulometry and cyclic voltametry. Thermal methods of analysis, Principles and important applications of thermo gravimetry (TG), differential thermal analysis (DTA), differential scanning calorimetry (DSC).

Unit V: Library project study
Catalogue, Journals and newspapers, Electronic databases

References

1. AI Vogel, A Text Book of Quantitative Inorganic Analysis, Longman, 5th edition, October 1989, London.

2. DA Skoog, M West, J Holler and SR Crouch, Fundamentals of Analytical Chemistry, 9th edition, Brooks / Cole, 2014, New York.

3. PJ Haines, Thermal Methods of Analysis: Principles, Applications and Problems, Springer, 1995, Netherlands.

4. JR Dean, AM Jones, D Holmes, R Reed, J Weyers and A Jones, Practical skills in chemistry, Pearson education Ltd., Prentice Hall, 2002.

5. CR Kothari, Research methodology, Methods and Techniques, New Age International publishers, March 2014, New Delhi.

6. AK Singh, Tests, Measurements and research methods in Behavioral sciences, Bharati Bhawan publishres and Distributors, 5th edition, 2017, New Delhi.

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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*
BSHCH 505 (I)	DE	Industrial Organic Chemistry	4	0	0	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A – Quiz/Assignment / Attendance, MST Mid Sem Test.

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

Course Objectives:-

The course will cover the applications of catalysis and organometallic reagents to chemical industries with special emphasis on special reagents that are used for selective transformations.

To give basic knowledge of catalysis, organo metallic reagent, supramolecular chemistry and ionic liquids. To develop the practical knowledge of organo metallic reagents, ionic liquids.

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 the following,

CO1. Be able to rationalise the importance of catalysts in various industrial process and this course on Indutsrial organic chemistry will provide the conceptual understanding of organo metallic reagents, supramolecular chemistry, and applications of Ionic liquids in industries.

CO2. The importance of practical knowledge and understanding of various industrail process.

Unit I: Catalysis

Fundamental aspects of Catalysis - Homogeneous & heterogeneous catalysis -The role of catalytic processes in modern chemical manufacturing -organometallic catalysts -catalysis in organic polymer chemistry -catalysis in petroleum industry - catalysis in environmental control.

Unit II: Organo metallic reagents

What is organo metallic reagent? Examples, type and use of organolithium and organoboron reagents in organic synthesis. Grubbs catalysts, Schrock, and Schrock-Hoveyda catalysts. Olefin and alkyne trimerization and oligomerization, Olefin polymerization using Ziegler-Natta, Titanium group metallocenes.

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Unit III: Applications of organo metallic reagents

Industrially important organo metallic reagents, types and examples. Wacker oxidation, Monsanto and Cativa processes, Palladium and nickel catalyzed cross coupling reactions such as Suzuki, Heck, Stille, Sonogashira, Negishi, Hiyama, Buchwald-Hartwig coupling reactions and Fischer-Tropsch Process.

Unit IV: Supramolecular chemistry

Non-covalent associations, Molecular recognition, Design and applications of molecular hosts: crown compounds, cyclophanes, cyclodextrins, etc., Nano technology, Molecular clefts. Tweezers and devices, self assembly and repliocation.

Unit V: Ionic liquids

Definition, examples, types, preparation, physical and chemical properties. Applications of Ionic liquids to synthesis.

Reference Books:

1. Cary, Sundberg A., Organic chemistry, Vol 1 & 2, Wiley Interscience, New York (2005)
2. Das, A. K., Green Chemistry, Wiley Eastern Ltd., New York (2017).
3. McMurry, Textbook of organic Chemistry, Oxford Univ. Press. (2014).
4. Jerry March, Oragnic reactions and mechanisms, McGraw Hill Press. (2010).

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SEMESTER V

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*
BSHCH 505 (II)	DE	Pharmaceutical Chemistry	4	0	0	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A – Quiz/Assignment / Attendance, MST Mid Sem Test.

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

Course Objectives:-

To give basic knowledge of Drug Design, types of drugs and mode of action, synthesis.
To develop the practical knowledge of Pharmaceutical 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 the following,
CO1. This course on Pharmaceutical Chemistry will provide the conceptual understanding of Drug design, Types of drug, properties, mode of action and synthesis of different drugs.
CO2. The importance of practical knowledge and understanding of the process involved in Pharmaceutical Chemistry.

UNIT I INTRODCUTION TO DRUG DESIGN

Terms used in Drug Design, Factors goevrning drug design – Merits. Types of drug, Literature survey for preparation of drugs. Structural elucidation of drugs using different spectral methods. Analgesics and types, Narcotic analgesics – Morphine analogues, synthesis and uses of following narcotic analgesics codeine, pethidines. Antipyretic analgesics, types and uses. Salicylic acid analogues – methyl salicylate, phenyl salicylate.

UNIT II ANTIHISTAMINES AND ANTIMALARIALS

Antihistamines – definition and classification structure, synthesis, uses, and actions (pharmacological) of Diphenhydramine, chlorpheneraminemaleate. Antimalerials classification and study of following drugs, Quinine-4-amino and 8-amino quinolines, Chloroquine phosphate, Pyrimidines and Acidines. Sedatives, structure, synthesis, action

and use of following Barbiturates, Phenobarbitol, Benzodiazepines. Mode of action structure and synthesis of Diazepam, Nitrazepam.

UNIT III ANTIBIOTICS AND ANTIBACTERIALS

Antibiotics, structure, mode of action and use of penicillin, chloramphenicol. Antibacterials, structure, mode of action and use of norfloxacin, Trimethoprim. Sulpha drugs, mode of action and preparation of sulphanilamide, sulphapyridine, sulphagauidine and sulphamethoxazole. Antifungals action, use and synthesis of following medicines clotrimazole, micronazole, Isoconazole.

UNIT IV ANTIHYPERTENSIVE AND ANTITUBERCULAR DRUGS

Anthihypertensive drugs– synthesis and mode of action of methyldopa, pargyline, bertyline, hydralazine, propranolol- Antitubercular drugs – synthesis of PAS, ethambutol – pyrazinamide, isoniazid.

UNIT V ANTIDIARRHEAL AGENTS

Antitussives and antineoplastic drugs, antidiarrheal agents – cimetidine, domperidone, loperamide; Expectorants – antitussives – guaiphenesin, ambroxal, bromohexine, dextromethorphan, Antineoplastic drugs - alkylating agents –nitrogen mustards – sulphonic acid esters.

Reference Books:

1. Berger, A.Medicinal chemistry, Vol 1&2, Wiley Interscience, New York (1990)
2. Asutoshkar Medicinal Chemistry, Wiley Eastern Ltd., Chennai (1992).
3. Bentely and Driver's Textbook of Pharmaceutical Chemistry, Oxford Univ. Press. (1985).
4. H.J Roth, A. Kleemann, Pharmaceutical chemistry vol.1 Drug synthesis (2001).

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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*
BSHCH 505 (III)	DE	Industrial Electro Chemistry	4	0	0	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A – Quiz/Assignment / Attendance, MST Mid Sem Test.

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

Course Objectives:-

To give basic knowledge of Electro chemistry and Industrial applications of Electro chemistry.

To give an in-depth idea of the Industrial process of applied Electro chemistry.

Course Outcomes:-

Student should be able to understand importance of Physical Chemistry. 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 the following,

CO1. This course on Industrial Electro Chemistry will provide the conceptual understanding of principles of Electro chemistry, Industrial applications of Electrochemistry.

CO2. The importance of Electro metallurgy, Electro synthesis and Industrial electrochemical processes.

UNIT I CHLORALKALI INDUSTRY

General concepts of brine electrolysis, modern technological developments – chlorine cell technologies, Mercury and diaphragm cell – membrane cell

UNIT II ELECTRO METALLURGY

Metal extraction and refining – electrowinning – aluminum extraction – manufacture of sodium, lithium and magnesium – hydrometallurgical processes – electrorefining – aqueous and molten salt electro refining

UNIT III METAL FINISHING

Pretreatment – conversion coatings – phosphating – types –methods – properties and influencing factors – evaluation and testing – applications – anodizing – principle and applications. Electroplating – objectives – theory – method – electroplating of nickel – electroless plating – galvanizing –tinning

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UNIT IV ELECTRO SYNTHESIS

Electrolytic preparation of inorganic compounds – fluorine – peracids and their salts – $KMnO_4$, $K_2Cr_2O_7$. Organic electrosynthesis – hydromerisation of acrylonitrile – Monsanto process – Manufacture of ethylene glycol – electrolysis of organic compounds with the use of ion – exchange membranes.

UNIT V INDUSTRIAL ELECTROCHEMICAL PROCESSES

Water treatment and environmental protection – metal ion removal and metal recovery – electro-filtration of particulates from gases – electrodialysis – desalination – electroflotation

Reference Books:

1. P.H. Rieger, Electrochemistry, Prentice Hall, Inc, New York (1987).
2. D Fletcher, Industrial electrochemistry, Chapman and Hall, London (1982).
3. J.Bockris and A.K.M.Reddy, "Modern electrochemistry, Vol.II, Mac Donold, London (1970).
4. C.Rajagopal and K. Vasu, Conversion Coatings, 1st Edn. Tata McGraw Hill, New Delhi (2000).