VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Chemistry

SYLLABUS

Master of Science
(IV Semester)

With effect from:
2021-22

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Journalism and Mass Communication

Jnana Sagara, Ballari - 583105

Distribution of Courses/Papers in Postgraduate Programme I to IV Semester as per Choice Based Credit System (CBCS) Proposed for PG Programs

M.Sc. IV-SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
FOURTH	DSC11	21CHE4C11L	Bioinorganic and Organometallic chemistry	30	70	100	4	-	-	4	3
	DSC12	21CHE4C12L	Thermodynamics	30	70	100	4	-	-	4	3
	DSE3	21CHE4E3AL	A. Modern Organic synthesis	30	70	100	4	-	-	4	3
		21CHE4E3BL	B. Natural products of Biological Importance								
		21CHE4E3CL	C. Bioorganic chemistry								
	DSE4	21CHE4E4AL	A. Advanced Chromatographic and Microscopic techniques	30	70	100	4	-	-	4	3
		21CHE4E4BL	B. Applied Analysis								
		21CHE4E4CL	C. Environmental and Biochemical Analysis								
	GEC2	21CHE4G2AL	A. Chemistry for daily life	20	30	50	2	-	-	2	1
		21CHE4G2BL	B. Water and food quality and laws								
		21CHE4G2CL	C. Agro and Environmental Chemistry								
	DSC11P9	21CHE4C11P	Spectral interpretation of data	20	30	50	-	-	4	2	4
	Project	21CHE4C1R	Project work	30	70	100		-	8	4	4
Total Marks for IV Semester						**600**				**24**	

(I-IV semester)- Total Marks: 2400 and Total credits: 96

DSC – Department Specific Core, DSE – Discipline Specific Elective, SEC – Skill Enhancement Course, GEC – Generic Elective Course, IA – Internal Assessment, SEE – Semester End Examination, L – Lecture, T – Tutorial, P – Practical

Dept. Name: Chemistry
Semester-IV

DSC11: Bioinorganic and Organometallic chemistry

Course Title: Bioinorganic and Organometallic chemistry	Course code: 21CHE4C11L
Total Contact Hours: 56	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 h
Summative Assessment Marks: 70	

Course Outcomes (CO's):

1. Understand the various aspects and concepts of bioinorganic chemistry.
2. Study the synthesis, properties and stability aspects of organometallic compounds.
3. Understand biologically important metal ions.

At the end of the course, students will be able to:

1. Gain advanced knowledge on biological functions of metal ions and their importance.
2. Able to understand the transportation of oxygen in biology.
3. Understand the synthesis and practical applications of organometallic compounds

Unit	Description	Hours
I	**Metal Ions in Biological Systems:** Outline of metal ions in biology, Essential and types metals, active transport of Na and K, ionophore. **Metal Functions in Metalloprotein:**Dioxygen Transport, Electron Transfer, Structural Roles for Metal Ions. **Metalloprotein as enzymes** – carboxy peptidase, (catalases, peroxidases, cytochrome P450, copper oxidases), vitamin B_{12} coenzyme, enzyme action inhibition and poisoning. Synthetic model compounds, Interactions of Metal Ions and Nucleic Acids, Metal-Ion Transport and Storage, Metals in Medicine, **Metalloenzyme Function:** Hydrolytic Enzymes, Two-Electron Redox Enzymes, Multielectron Pair Redox Enzymes, Rearrangements. **Metals in medicine** – Metal deficiency (Fe, Mn, Cu and Zn), chelation therapy and metal complexes as drugs.	12
II	**Heme and Non-heme Systems**: Chlorophyll and its role in photosynthesis, transport and storage of dioxygen –heme proteins, oxygen uptake, functions of Haemoglobin, myoglobin, hemerythrin, and hemocyanins, synthetic oxygen carriers, metal storage and transport – ferritin and transferrin, Electron transfer proteins – cytochromes and iron sulphur proteins. **Iron-Containing Proteins and Enzymes:** **Introduction:** Iron-Containing Proteins with Porphyrin, Ligand Systems, Myoglobin and Hemoglobin, Myoglobin and Hemoglobin Basics, Structure of the Heme Prosthetic Group, Behavior of Dioxygen Bound to Metals , Structure of the Active Site in Myoglobin and Hemoglobin, Binding of CO to Myoglobin, Hemoglobin, and Model Compounds. **The Frontiers of Bioinorganic Chemistry:** Choice and Uptake of Metal Ions, Control and Utilization of Metal-Ion Concentrations,	11

	Metal Folding and Cross-Linking, Binding of Metal Ions to Biomolecules, Electron-Transfer Proteins, Substrate Binding and Activation, Atom- and Group-Transfer Chemistry, Protein Tuning of the Active Sites.	
III	**Group I and II Metals in Biological Systems:** **Homeostasis and Group I Biomolecules:** Homeostasis of Metals (and Some Nonmetals), Phosphorus as Phosphate, Potassium, Sodium, and Chloride Ions, Calcium Homeostasis. **Group II Biomolecules:**Magnesium and Catalytic RNA, Analyzing the Role of the Metal Ion, The Group-I Intron Ribozyme, The Hammerhead Ribozyme, Calcium-Dependent Molecules. **Biological nitrogen fixation**: in-vivo and in-vitro nitrogen fixation.	11
IV	**Organometallic Reaction mechanisms** Fundamental reactions, substitution in carbonyl complexes, Mechanisms, Insertion reactions, CO, SO_2, olefin insertions, oxidative additions, one electron, addition of oxygen, reductive elimination, CH activation. **Hydrogenation**: Hydrogenation of olefins (oxo reaction-cobalt and rhodium oxo catalysts), carbonylation of alcohols – Monsanto acetic acid process, Wacker process. **Catalysis** Use of Organometallic Compounds as catalysts – Catalytic behavior – Homo catalysis – Anchoring of Catalysts **Polymerization of olefins and acetylenes**: Ziegler – Natta catalysis systems. Fischer – Tropsch reaction, Water Gas Shift reactions.	11
V	**Chemistry of Inorganic materials:** Synthesis of bulk materials, Chemical deposition, defects and ion transport, metal oxides, nitrides and fluorides, chalcogenides, chevrel phases and thermoelectric, Framework structures, hydrides and hydrogen storage materials, Inorganic pigments, molecular materials and fullerides. **Organometallic polymers:** Polymers with organometallic moieties as pendant groups, moieties in the main chain, ferrocene based condensation polymers, condensation polymers based on rigid polymers.	11

References:

1. The Inorganic Chemistry of Biological process – M.N. Hughes, 2nd Edn. John Wiley and sons, 1988.
2. Bioinorganic Chemistry – R.N. Hay, Ellis Horwood Ltd., 1984.Biological Inorganic Chemistry – An Introduction, R.R. Crichton, Elsevier, 2008.
3. Transition Metal Complexes as Drugs and Chemotherapetic Agents – N. Farrel Kluwer Academic Publication, 1989.
4. Inorganic Chemistry – I.E. Huheg, R.L. Keiter and A.L. Keiter, 4th Edn, Addison Wesley, 2000
5. Bioinorganic Chemistry – A.K. Das, Books & Allied (P) Ltd., 2007.
6. Organometallic Chemistry – R.C. Mehrothra and A. Singh, 2nd Edn., New Age, International Publications, 2006.
7. Fundamental Transition Metal Organometallic Chemistry – Charles M Lukehart, Brookes, Govel Publishing Company, 1985
8. The Organometallic Chemistry of the Transition metals: R H. Crabtree, 4th Edn., Wiley Interscience,2005.
9. Basic Organometallic Chemistry – B.D. Gupta and A.J. Elias, Universities Press, 2010.
10. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine: Bioinorganic Chemistry, University Science Books., 1994/2010
11. R.C. Mehrothra ad A. Singh: Organometallic Chemistry, New Age International, 2nd Edn.. 2004.
12. F.A. Cotton and G. Wilkinson: Advanced Inorganic Chemistry, 6th Edition, Wiley, 1999.

13. Concepts and Models of Inorganic Chemistry, Douglas, McDaniel, Alexander, 3rd Ed., Wiley India, 2012.

Date Course Coordinator Subject Committee Chairperson

DSC12: **Thermodynamics**

Course Title	Course code: 21CHE4C12L
Total Contact Hours:56	Course Credits:04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3H
Summative Assessment Marks:70	

Course Outcomes (CO's)

1. Understand the various aspects and concepts of Thermodynamics.
2. Study the Statistical, Chemical, Classical and Nonequilibrium Thermodynamics.
3. Review of some importance and applications of Thermodynamics.

At the end of the course, students will be able to:

1. Gain through knowledge on basics of thermodynamics.
2. Able to compare different parts of Thermodynamics.
3. Understand the practical applications of Thermodynamics.

Unit	Description	Hours
I	**Chemical Thermodynamics** A brief resume of laws of thermodynamics (combined form of $1^{st}$and 2^{nd}laws), entropy as a measure of unavailable energy, concept of fugacity and free energy, entropy and free energy changes and spontaneity of processes. Variation of free energy with T & P. Maxwell's relations, thermodynamic equations of state, limitations of Van't Hoff' s equation, Nernst Heat theorem & its applications. Thirdlaw of thermodynamics, determination of third law of entropies.	**11**
II	**Classical Thermodynamics:** Brief resume of concepts of laws of thermodynamics, chemical potential and entropies. Partial molar properties – partial molar free energy, partial molar volume, partial molar heat content, their significance. Determination of these quantity concept of fugacity and its determine by graphical method and compressibility factor method. Non-ideal systems – excess functions for non-ideal solutions. Relationship between mole fraction, molality and molarity activity co-efficients. Determination of activity co-efficient by EMF and solubility methods.	**11**
III	**Statistical Thermodynamics:** Concepts of distribution, most probable distribution, Maxwell-Boltzmann distribution law. Partition functions – translational, rotational, vibrational and electronic partition functions. Calculation of thermodynamic properties in terms of partition functions. Fermi – Dirac Statistics – distribution law and applications to metal. Bose-Einstein statistics – distribution law and application to solids. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro canonical ensembles with corresponding distribution laws (using Lagranges method of undetermined multipliers).	**11**
IV	**Application of Thermodynamics:** Entropy and free energy of mixing, partial molar quantities, partial molar volume and free energy (chemical potential), their significance and determinations. Gibbs- Duhem and Duham-Margules equations. **Thermodynamics of Ideal Solutions**: Deductions of laws of Raoult's ebullioscopy, cryoscopy and osmotic pressure. Quantitative treatment of Le-Chatelier principle. **Thermodynamics of Non-ideal Solutions**: Activity, activity coefficient-standard states.	**11**
V	**Non-equilibrium thermodynamics**: Thermodynamic criteria for non-equilibrium states, Assumptions of non-equilibrium	**12**

	thermodynamics, uncompensated heat, entropy production and entropy flow, entropy balance, Onsager formalism, relation between forces and fluxes, transformations of generalized fluxes and forces, microscopic reversibility and Onsager's reciprocity relations. Electrokinetic phenomena, diffusion, electric conduction, irreversible thermodynamics for biological systems, coupled reactions.	

References:

1. Molecular thermodynamics – Donald A. Mc Quarrie, John D. Simon University Science Books, California, 1999.
2. Thermodynamics of Chemistry – S. Glastone, Affiliated East-West Press, New Delhi, 1960.
3. Statistical Thermodyanics – M.C. Gupta, Wiley Eastern Ltd., 1993.
4. Text Book of Physical Chemistry – Samuel Glastone, McMillan Indian Ltd., 2nd Edn. 1974.
5. Elements of Physical Chemistry – S. Glastone, McMillan Indian Ltd., 2nd Edn., 1963.
6. Modern Thermodynamics, A , Diego Casadei, Wolrd Scientific Publisher, 2016.
7. Thermodynamics and Statistical Mechanics of Macromolecular Systems, Michael Bachman, Cambridge, 2014.
8. A Textbook of Physical Chemistry, Dynamics of Chemical Reactions, Statistical Thermodynamics, Macromolecules and Irreversible Processes (Vol. 5), by K.L. KAPOOR

Date Course Coordinator Subject Committee Chairperson

DSE3: A. Modern Organic synthesis

Course Title:Modern Organic synthesis	Course code: 21CHE4E3AL
Total Contact Hours:56	Course Credits:04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3H
Summative Assessment Marks:70	

Course Outcomes (CO's)

1. Understand basic concepts of heterocyclic transformation and rearrangements.
2. Predict the mechanism of Stereoselectivity and Retrosynthesis
3. Study thoroughly the basic concept of photochemistry
4. Understanding biochemistry of natural compounds

At the end of the course, students will be able to

1. Acquire knowledge on heterocyclic reaction mechanism.
2. Acquint with important mechanism of Stereoselectivity and Retrosynthesis.
3. Gain knowledge on photochemical reactions of organic compound.
4. Able to gain knowledge of basic biochemistry of natural compounds

Units	Description	Hours
I	**Heterocyclic transformations and rearrangements** Heterocyclic Transformations: (i) Coumarins to benzofurans (ii) Sydonones to Pyrazoles (iii) Chromones to Pyrazoles (iv) Furans to Pyridines. **Heterocycles in Functional Group Transformations:** (i) Alkanes from Thiophenes. (ii) Cycloalkanes from Pyrazolines. (iii) Dienes from Pyrroles. (iv) Alcohols from isoxazodiolines. **Rearrangements in Heterocycles:** (i) Dimoroth Rearrangement (ii) Boulton-Katritzky Rearrangement (iii) Fischer Indole cyclisation (iv) Patterno-Buchi reaction.	**11**
II	**Stereoselectivity and Retrosynthesis, Stereoselectivity:** Classification, terminology, and the principle of Stereoselectivity, Strategy of stereoselective synthesis. Acyclic stereo selection.Enantioselective synthesis, diasteroselection in cyclic compounds. Catalytic hydrogenation, alkylation, stereoselective formation of the double bond, stereoselective cyclization of polyenes. Protection and deprotection of functional groups. **Retrosynthesis**: Introduction, retrosynthetic strategies for target molecules: group-oriented strategies, functional group interconversion (FGI), functional group addition (FGA), and functional group removal. **Disconnection approach:** Disconnection of bonds in ring systems and bonds joining ring atoms to functional groups or other residues. Retro Diels-Alder reaction. Retroanalysis of Benzocaine, Indole-3-acetic acid, cyanohydrins, 6-methyl quinoline.	**12**
III	**Organic Photochemistry**	

	Interaction of electromagnetic radiation with matter, types of excitations, Jablonski diagram, the fate of excited molecule, quantum yield, transfer of excited energy. **Intramolecular reactions of the olefinic bond:** Geometrical isomerism, cyclization reactions, rearrangement of 1,4 – and 1,5 – dienes. **Intramolecular reactions of carbonyl compounds:** Saturated, cyclic, and acyclic. α, β-unsaturated compounds, Norrish Type I and II reactions, and photochemistry of cyclohexadienones. **Intermolecular cycloaddition reactions:** Dimerisations and oxetane formation. Patterno Büchi Reaction. Isomerization, addition, and substitutions of aromatic systems.	**11**
IV	**Steroids and Sex hormones** Introduction, classification, sterols, sex hormones, androgens, estrogens. Non-steroidal estrogens and their clinical applications. **Synthesis and mode of action of hormones:** Androsterone, testosterone, and estrone. **Synthesis and therapeutic applications of non-steroidal hormones:** diethylstilbestrol, hexestrol and dienestrol. **Progestins**: progesterone and norethynodrel.	**11**
V	**Genetic code and structure Cell membrane** **Genetic code:** protein synthesis and role of various types of RNA, micro RNA and its functions, inhibitors of protein synthesis, enzyme induction, Operon concept. DNA replication, recombinant DNA technology, and genetic engineering, Plasmids, Vectors, gene cloning gene libraries, screening of gene libraries, Insertion of foreign DNA into cells, Methods to study gene expression, Polymerase chain reaction (PCR). **Cell membrane structure:** Fluid mosaic model of membrane structure, Membrane fluidity, Mechanism of organic solute transport, Lonophores, and their applications, Membranes channels, Liposomes.	**10**

REFERENCES:

1. An Introduction of the Chemistry of Heterocyclic Compounds – R.M. Achenson, 4th Edn., John Wiley & Sons. 2008
2. The Principles of Heterocyclic Chemistry – A.R. Katritzky and J.J. Logowski, 2013
3. Heterocyclic Chemistry – R.K. Bansal, 3rd Edn., New Age International Publishers (2002).
4. Organic Chemistry: Carey. 2019
5. Stereochemistry: Conformation and Mechanism 7th ed. Edition– P. S. Kalia, 2009
6. Stereochemistry of Organic Compounds: Principles and Applications – D. Nasipuri, 1991.
7. Designing Organic Syntheses: A Programmed Introduction to the Synthon Approach – S. Warren, Wiley. Wiley; 1st edition, 1978
8. Burger's Medicinal Chemistry, Drug Discovery, and Development– Burger, 2010.
9. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry – Wilson and Gisvold. Lippincott Williams and Wilkins; 12th revised North American ed edition, 2010.
10. Bentley's Textbook Of Pharmaceuticals (Old Edition)– B.A. Rawlins Elsevier/bsp Books Pvt. Ltd. (bsp), 2010
11. The Organic Chemistry of Drug Design and Drug Action Hardcover-R. B. Silverman, Academic Press; 3rd Edn.,2014.

12. Textbook of organic medicinal and pharmaceutical chemistry, Ed. Robert E. Dorge, Lippincott, Philadelphia, ©1977.
13. Fundamentals of photochemistry, K.K. RohtagiMukhjerji, Wiley – Eastern, Wiley Eastern Ltd., New Delhi, Bangalore, Bombay 1978.
14. Organic Photochemistry (Cambridge Texts in Chemistry and Biochemistry), J. Coxon and B. Halton, Cambridge University Press; 2nd edition, 2011.
15. Molecular reactions and photochemistry, Depuy and Chapman.Prentice Hall, 1972.
16. Molecular Biotechnology, Glick and Pasteynak, American Society for Microbiology; 4th edition, 2010.
17. Physical Biochemistry, Frifielder, 1983
18. Principles of Biochemistry, A. L. Lehninger, WH Freeman; 7th ed. 2017.
19. Recombinant DNA: Short Course, J.D.Watson, WH Freeman; 3rd ed. 2006.

Date Course Coordinator Subject Committee Chairperson

DSE3: B. Natural products of Biological Importance

Course Title: Natural products of Biological Importance	Course code: 21CHE4E3BL
Total Contact Hours:56	Course Credits:04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3H
Summative Assessment Marks:70	

Course Outcomes (CO's)

1. Understand the structure and biochemistry of Proteins, Peptides and Nucleic acids.
2. Study structure and function of Lipids, Vitamins and Polysaccharides
3. Gain knowledge onenzymatics mechanism and biogenesis of natural compounds

At the end of the course, students will be able to

1. Gain knowledge on structure and determination of protein, peptides and nucleic acids.
2. Students able to understand the mechanism of enzyme reactions.
3. Able to synthesize selected natural products.

Units	Description	Hours
I	**Proteins and Peptides** **Proteins**: Structure determination: C and N terminal residue determination, primary, secondary, tertiary, and quaternary structure determination, denaturing and denaturing of proteins. **Peptides**: Structure and conformation of the peptide bond, peptide synthesis: Solution phase and Merrifield's solid-phase synthesis, Racemization and use of HOBt, Synthesis of oxytocin and vasopressin.	11
II	**Nucleic acids**: Introduction, structure and synthesis of nucleosides and nucleotides, protecting groups for the hydroxy group in sugar, the amino group in the base and phosphate functions. Methods of formation of internucleotide bonds: DCC, phosphodiester approach and phosphoramide methods. **Polysaccharides:** Different classes, structure and function of polysaccharides, homo and heteropolysaccharides, mucopolysaccharides, proteoglycans, bacterial polysaccharides, mucins blood group substances, lectins and their functions.	11
III	**Lipids, Vitamins and Coenzymes:** **Lipids**: Simple and complex lipids, triacylglycerol phospholipids, plasmalogens, cardiolipids, glycolipids, gangliosides and cerebrosides. **Vitamins and Coenzymes:** Classification- Fat soluble and water-soluble vitamins (source, biological functions and deficiency disorders), coenzyme forms of the vitamin B complex.	11
IV	**Chemistry of enzymes:** Introduction, nomenclature, classes and general types of reactions catalyzed by enzymes. Properties of enzymes: i) Enzyme efficiency/catalytic power ii) Enzyme specificity; Fischer's 'lock and key' and Koshland 'induced fit' hypothesis. Concept and identification of active site. **Factors affecting enzyme kinetics**: Substrate concentration, enzyme concentration, temperature, pH, product concentration etc. Reversible and irreversible inhibition. **Mechanism of enzyme action:** transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Mechanism of chymotrypsin catalyzed hydrolysis of a peptide bond.	12

V	**Biogenesis and biosynthesis of natural products:** **Biogenesis**: Precursors, primary and secondary metabolites. Acetate hypothesis. Mevalonate and Shikimic acid pathways. General principles involved in the biosynthesis of amino acids, alkaloids, steroids and terpenoids. **Biosynthesis of selected natural products:** L-tryptophan, cholesterol, ephedrine, citronellol.	11

References

1) L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.

2) K. Albert, L. Lehninger, D.L. Nelson, M.M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.

3) Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.

4) Encyclopedia of Chemical Technology – Kirck-Othmer series, 4 December 2000

5) Harper's Review of Biochemistry – P.W. Martin, P.A. Mayer and V.W. Rodfwell, 15th edition, LANGE Medical Publications, 1981.

6) Maurzen Asian Edition, California, 1981.

7) Immobilized biocatalysts, Winfried Hartmeister, Springer Berlin, Heidelberg,1988

8) Molecular Biotechnology, Glick and Pasteynak, American Society for Microbiology; 3rd edition, 2002

9) Principles of Biochemistry, A. L. Lehninger, WH Freeman; 7th ed. 2017 edition, 2017

10) Biochemistry, L.Stryer, WH Freeman; 8th ed. Edition, 2015

11) Biochemistry, VoietasVoiet, Wiley; 5th edition, 2018

12) Bioorganic, Bioinorganic and Supramolecular chemistry, P.S. Kalsi and J.P. Kalsi. New Age International Publishers, New Age International Pvt Ltd Publishers, 2008

13) The Organic Chemistry of Enzyme-Catalysed Reactions, Academic Press, By Richard B. SilvermanJ. Am. Chem. Soc. 2000, 122, 33, 8103–810, 2000

14) Enzymes: Practical Introduction to structure, mechanism and data analysis, By Robert A. Copeland, Wiley-VCH, Inc.,2000.

15) The Organic Chemistry of Biological Pathways By John McMurry, Tadhg Begley by Robert and company publishers. WH Freeman; 2nd edition, 2015

16) Bioorganic Chemistry- A practical approach to Enzyme action, H. Dugas and C. Penny. Springer Verlag, 1931.

17) Biochemistry: The chemical reactions in living cells,By E. Metzler. Academic Press. Academic Press; 2nd edition, 2003

18) Concepts in biotechnology by D. Balasubrarnanian& othersUniversities Press, 2004

Date Course Coordinator Subject Committee Chairperson

DSE3: C. Bioorganic chemistry

Course Title: Bioorganic chemistry	Course code: 21CHE4E3CL
Total Contact Hours:56	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3H
Summative Assessment Marks:70	

Course Outcomes (CO's)

1. Understand the chemistry of living cell.
2. Study enzymatic reactions and their biotechnological applications.
3. Gain knowledge onPharmacokinetics and pharmacodynamics of drug design.

At the end of the course, students will be able to

1. Aquint knowledge on how chemical reactions occur at the cellular level.
2. Acquire skills and information on technological applications of enzyme actions in biology.
3. Gain knowledge on inventive process of finding new medications based on the knowledge of a biological target

Units	Description	Hours
I	**Introduction to Bioorganic Chemistry**: Overview of Bioorganic Chemistry- Historical Connection Between Organic and Biological Chemistry; Weak Interactions in Organic and Biological World; Proximity Effect in Organic Chemistry; Molecular Recognition. **Chemistry of the Living Cells:** Analogy Between Biochemical and Organic Reaction, Chemistry of the Peptide Bond, Nonribosomal Peptide Bond Formation, Asymmetrie Synthesis of a-Amino Acids, Asymmetrie Synthesis with Chiral Organometallic Catalysts.	11
II	**Enzymes and enzyme-catalyzed reactions** **Enzymes**:Multifunctional Catalysis and Simple Models, Introduction and historical perspective, α-Chymotrypsin , chemical and biological catalysis. **Enzymes properties:** Remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. **Enzyme kinetics:** Michaelis-Menten and Lineweaver- Burk plots, reversible and irreversible inhibition. **Kinds of Reactions Catalysed by Enzymes:** Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulfate, addition and elimination reaction, enolic intermediates in isomerization reactions, -cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.	12
III	**Coenzymes and biotechnological applications** **Co-Enzyme Chemistry:**Oxidoreduction, Pyridoxal Phosphate, Suicide Enzyme Inactivators and Affinity Labels, Thiamine Pyrophosphate, Cofactors as derived	10

	from vitamins, coenzymes, prosthetic groups, apoenzyme. **Structure and biological function of coenzyme**: Thiamine pyrophosphate, Pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B_{12}. Mechanism of reaction catalyzed by the above cofactors,Biotin.	
IV	**Drug design** Introduction to drug designing, combinatorial chemistry approach, lead-based methods, the discovery of lead compounds, drug discovery without a lead-denevo drug designing, Prodrug, concepts for drug design, conceptual pharmacokinetics in drug designing.	10
V	**Pharmacokinetics and pharmacodynamics** **Pharmacokinetics**: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models.Significance of Protein binding. **Pharmacodynamics**: Mechanism of drug action. The relationship between drug concentration and effect Receptors.Structural and functional families of receptors. Quantitation of drug receptors interaction and elicited effects	12

References:

1, Hermann Dugas: Bioorganic Chemistry-A chemical Approach to Enzyme Action; 3rd Edition. Springer; 3rd ed. 1996. CBS Publishers and Distributors Pvt. Ltd., 2nd printing edition 1999.

2. Page, M.I.; Williams, A. Enzyme Mechanisms, Royal Society of Chemistry. 1987

1. Silverman, Richard B. Organic Chemistry of Enzyme Catalyzed Reaction.Academic Press; 2nd edition, 2002
2. Bertini, I.; Gray, H.B.; Lippard, S. J.; Valentine, J.S. Bioinorganic Chemistry, University Science Books.University Science Books,U.S. , 1994
3. Drug Designs - A series of monographs in medicinal chemistry edited by A. J. Ariens. Istedition, Vol. I, II, V, VIII & IX (only relevant chapters).1st Edition - 1978
4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.ADIS Health Science Press, 1983
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.YuMcGraw Hill / Asia; 7th edition, 2016.

Date Course Coordinator Subject Committee Chairperson

DSE4: A. Advanced Chromatographic and Mass spectroscopic techniques

Course Title: Advanced Chromatographic and Microscopic Techniques	Course code: 21CHE4E4AL
Total Contact Hours: 56	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 h
Summative Assessment Marks: 70	

Course Outcomes (CO's):

1. Understand the importance of inorganic spectral methods and structural aspects.
2. Study the advanced and instrumental separation techniques

At the end of the course, students will be able to:

1. Combining the different spectral information to gain additional analytical skills.
2. Confirmation of molecular structures from the available data.

Unit	Description	Hours
1	**Instrumental methods of chromatography:** General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase and nature of adsorbents. Column chromatography: Theories, plate theory, rate theory, band broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column efficiency, Van Deemter's equation and its modern version, interrelationships, capacity factor, selectivity factor, column resolution, distribution constant and applications of conventional column chromatography, advantages and limitations. **Gas Liquid Chromatography:** Principle, instrumentation, apparatus-columns, sample application, mobile phase, stationary phase, detectors, thermal conductivity, flame ionization and mass spectrometry, factors affecting separation, retention volume, retention time and applications. **HPLC Principles:** Instrumentation- columns, stationary phase and matrices, column packing, sample application, mobile phases, pumps, detectors ,advantages and applications.	12

2	**Mass Spectroscopy:** Introduction – Basic theory, ionsation, types of ions – molecular ion, fragment ion, meta stable ion and isotope ions, base peak, instrumentation. Fragmentation processes, representation of fragmentation, basic fragmentation types and rules factors affecting fragmentation and reaction pathways. Intensity of M^+ peaks of alkanes, alkenes, alkynes, alcohols, amines, aldehydes and other compounds. Ion analysis, ion abundance, Fragmentation patterns of glucose, myrcene, nicotine, retro Diels-Alder fragmentation. Mc Laffarty rearrangement, nitrogen rule, some simple examples of fragmentations, applications of mass spectrometry. Application in structure elucidiation and evaluation of heats of sublimation & ionization potential. High resolution mass spectroscopy. GC-MS and LC-MS. Composite problems involving the applications of UV, IR, 1H and 13C-NMR and mass spectroscopic techniques. Structural elucidation of organic molecules.	11
3	**Molecular Luminescence:** Principles of Fluorescence and Phosphorescence - Fluorimetry in Chemical Analysis - Instrumentation in Fluorimetry - Fluorescence and Chemical Structure and - Fluorescence in quenching and inner filter effect - Phosphorescence Spectroscopy – Jablonski diagram- Phosphorescence and Chemical Structure - Phosphorimetry in Quantitative Analysis. **Chemiluminescence:** Principles, measurement of Chemiluminescence - Quantitative Analysis - Titrations - Electrochemiluminescence. **Polarimetry and Related Methods :** Polarized light - Applications of Polarimetry - Optical Rotatory Dispersion and Circular Dichroism –cotton effect, Instrumentation in ORD and CD.	11
4	**Electron Spin Resonance Spectroscopy:** Introduction - Presentation of spectrum – ESR transitions and selection rules Hyperfine splitting in various structures – Factors affecting "g" values. Zero field splitting and Kramer's degeneracy Anisotropy in Hyperfine coupling constant – Nuclear Quadrupole interactions – Spin Hamiltonian – Electron delocalization instrumentations and applications to simple inorganic and organic free radicals and to inorganic complexes. **Mössbauer Spectroscopy** Introduction – Mössbauer effect – Resonance absorption of gamma rays conditions for Mössbauer spectroscopy – Mössbauer parameters – Isomer shift – electric quadruple interaction – Magnetic interactions – Instrumentation & applications to $Fe_3(CO)_{12}$, Prussian blue, Oxyhemerythrin, Hexacyano ferrates, Netroprusside and Tin halides. Application to the study of Fe2+ and Fe3+ compounds, Sn2+ and Sn4+ compounds(nature of M-L bond, coordination number and structure), detection of oxidation states and inequivalent Mössbauer atoms **Nuclear Quadruple Resonance Spectroscopy:** Introduction – Nuclear Quadruple Moment – Electric field gradient – Asymmetry parameter – Nuclear Quadruple transition – Effect of external magnetic field – Applications.	11
5	**Electroseparation techniques:** **Supercritical fluid chromatography:** Introduction, Properties of supercritical	11

	fluids, Instrumentation, and applications. **Electrophoresis:** Principle, classification, capillary electrophoresis, Instrumentation, Application to capillary zone electrophoresis, gel electrophoresis. **Electrosmosis:** Principles, Instrumentation and applications. **Field flow fractionation:** Separation mechanisms, Methodology, Advantages over chromatographic methods.	

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York, 2005.
2. Analytical Chemistry, G.D. Christian, 5th ed., John Wiley & Sons, Inc, India, 2001.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, prentice Hall, Inc. New Delhi, 1993
4. Spectroscopy of Organic compounds – P.S. Kalsi, Wiley Eastern Ltd. (India) / New Age International Publications, New Delhi (8h Edn.), 2020
5. Organic Spectroscopy – William Kemp 3rd Edn. ELBS, 1993
6. Application of absorption spectroscopy of organic compound – John R Dyer, Prentice Horll India, EEE, Recent Edn., 1965.
7. Instrumentatal Method of Chemical analysis – G.R. Chatwal and S.K. Anand, Himalaya Publication House, Delhi (Recent Edn.), 2011.
8. Instrumental methods of chemical analysis. – B.K. Sharma – Goel Publishing House – Meerut, 2014.
9. Molecular structures and Spectroscopy – G. Aruldhas, Prentice Hall India, New Delhi, 2008.
10. Spectroscopic methods in organic chemistry – D.H. Williams, I. Fleming – Tata McGraw Hill, 2007.

Date Course Coordinator Subject Committee Chairperson

DSE4: B. Applied Analysis

Course Title: Applied Analysis	Course code: 21CHE4E4BL
Total Contact Hours: 56	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 h
Summative Assessment Marks: 70	

Course Outcomes (CO's):

1. Understand the importance of analysis of various daily usable items like food, water, etc
2. Approach of various methods of analysis.
3. To know the methods of analysis for daily life

At the end of the course, students will be able to:

1. Apply fundamental and basic knowledge to analysis of various substance used in daily life.
2. Able to apply analytical techniques for different applications.

Unit	Description	Hours
1	**Food analysis**: Objectives of food analysis. Sampling procedures. Detection and determination of sugars and starch. Methods for protein determination. Oils and fats and their analysis – iodine value, saponification value and acid value. Rancidity - detection and determination (peroxide number). Tests for common edible oils. Analysis of foods for minerals - phosphorus, sodium, potassium and calcium. General methods for the determination of moisture, crude fibre and ash contents of food. Analysis of milk for fat and added water. Non-alcoholic beverages -determination of chicory and caffeine in coffee; caffeine and tannin in tea. Alcoholic beverages -methanol in alcoholic drinks and chloral hydrate in toddy. Food additives - chemical, preservatives - inorganic preservatives - sulphur dioxide and sulphites, their detection and determination. Organic preservatives - benzoic acid and benzoates, their detection and determination. Flavouring agents - detection and determination of vanilla and vanillin. Coloring	12

	matters in foods - classification, certified colors, detection of water soluble dyes, color in citrus fruits, beet dye in tomato products, mineral color. Pesticide residues in foods - determination of chlorinated organic pesticides. Control food quality - codex alimentarius, Indian standards.	
2	**Water pollution and analysis:** Water resources, origin of wastewater, types of water pollutants; their sources and effects, chemical analysis for water pollution control - objectives of analysis, parameters of analysis, sample collection and preservation. Environmental and public health significance and measurement of colour, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, chlorine demand, sulphate, fluoride, phosphates and different forms of nitrogen in natural and waste/polluted waters, heavy metal pollution - public health significance of Pb, Cd, Cr, Hg, As, Cu, Zn and Mn, general survey of the instrumental techniques for the analysis of heavy metals in aquatic systems, organic loadings – significance and measurement of DO, BOD, COD, TOD, and TOC, phenols, pesticides, surfactants and tannin and lignin as water pollutants and their determination.	8
3	**Kinetic methods of analysis:** I Introduction, basis of kinetic methods, rate law expressions. Classifying chemical kinetic methods – direct-computation integral methods, direct-computation rate methods, curve-fitting methods. Instrumentation. Quantitative applications – enzyme catalyzed reactions, non-enzyme catalyzed reactions, non-catalytic reactions. Determining Vmax, Km for enzyme catalyzed reactions. Elucidating mechanism for the inhibition of enzyme catalysis. Determination of enzymes, LDH, GOT and GPT. Determination of substrates – urea, uric acid, blood glucose and blood alcohol. Analysis of closely related compounds - neglect of reaction of slow reacting component method and logarithmic extrapolation method.	12
4	**Automated methods of analysis:** An overview. Principles of automation. Automated instruments: process control. Continuous analyzers. Discrete autoanalyzers. Instruments used in automated process control. Automatic instruments - discrete and continuous flow sampling instruments. Flow injection analysis – principles - dispersion co-efficient. Factors affecting peak height, sample volume, channel length and flow rate, and channel geometry. Applications -limited dispersion applications, medium dispersion applications, stopped flow methods and flow injection titrations. Discrete automatic systems - centrifugal fast scan analyzer, automatic organic elemental analyzers. Analysis based on multilayer films-general principles, film structures, instrumentation,performance and applications – blood urea nitrogen, blood glucose and potassium.	12
5	**Biomedical and forensic analysis:** Composition of body fluids and detection of abnormal levels of certain constituents leading to diagnosis of disease. Sample collection and preservation of physiological fluids. Analytical methods for the constituents of physiological fluids (blood, serum, urine). Blood - estimation of glucose, cholesterol, urea, haemoglobin and bilirubin. Urine - urea, uric acid, creatinine, calcium phosphate, sodium, potassium and chloride. 82Biological significance, analysis and assay of enzymes (pepsin, monoaminoxidase, tyrosinase); and hormones (progesterone, oxytocin, insulin). Chemical, instrumental and biological assays to be discussed wherever necessary.	12

	Forensic analysis: General discussion of poisons with special reference to mode of action of cyanide, organophosphates and snake venom. Estimation of poisonous materials such as lead, mercury and arsenic in biological materials.	

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, Saunders College Publishing, New York, 2005.
2. Analytical Chemistry, G.D. Christian, 5th edition, John Wiley & Sons, Inc. India, 2001.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, Prentice Hall,Inc. New Delhi, 1993.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd., New Delhi, 2003.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Instrumental Methods of Analysis by H.H. Willard, L.L. Merritt and J.A. Dean, 7th edition, 1988.
7. Principles and Practice of Analytical Chemistry, F.W. Fifield and Kealey, 3rd edition, Blackwell Sci., Ltd. Malden, USA, 2000.
8. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.
9. Introduction to Instrumental Analysis, Braun, Pharm. Med. Press, India, 2nd Edn., 2019.
10. Instrumental Methods of Analysis, W. M. Dean and Settle, 7th edition, CBS Publishers, New Delhi, 1986.
11. Instant Notes of Analytical Chemistry, Kealey and Haines, Viva books Pvt. Ltd., 2002.
12. Soil Chemical Analysis, M.L. Jackson, Prentice Hall of India Pvt. Ltd., New Delhi, 1973.
13. Clinical Chemistry, Principles and Procedures, J.S. Annino, 2nd edition, Boston: Little,Brown, 1960.
14. Clinical Chemistry, Principles and Techniques, R.J. Henry, D.C. Cannon and J.W.Winkleman, Eds., 2nd edition, Hagerstorm, M.D: Harper and Row, 1974.
16. Fundamentals of Clinical Chemistry, N.W. Tietz, Ed., 2nd edition, Philaddphia: W.B.Saunders, 1976.
17. Food Analysis, A.G. Woodman, McGraw Hill. 1971.
18. Chemical Analysis of Foods, H.E. Cox and Pearson, 1962.
19. Analysis of Foods and Food Products, J.B. Jacob, 2013
20. A First Course in Food Analysis, A.Y. Sathe, New Age Internationals (P) Ltd., Publishers, Bangalore, 1999.

Date Course Coordinator Subject Committee Chairperson

DSE4: C. Environmental and Biochemical Analysis

Course Title: Environmental and Biochemical Analysis	Course code: 21CHE4E4CL
Total Contact Hours: 56	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 h
Summative Assessment Marks: 70	

Course Outcomes (CO's):

1. Study sources and effects of air, soil pollution
2. Understand the analysis of food and fuel analysis.

At the end of the course, students will be able to:

1. Able to analysedifferent types of pollutants in air, water and soil.
2. Capable to analyse food and fuels.

Unit	Description	Hours
1	**Environmental Segments and Air Pollution:** Air pollutants, prevention and control, Greenhouse effect and acid rain. CO – industrial and transportation sources. So_x- sources, ambient concentration, test methods, control techniques – scrubbing, limestone injection process. Ozone hole and CFC's. Photochemical smog and PAN. NO_x – sources, ambient concentration, test methods, thermodynamics and NO_x, control techniques. Particulates: size distribution. Bhopal gas tragedy. Noise pollution. Composition of soil – Inorganic and organic components in soil, micro and macro nutrients, nitrogen and sulfur pathways.	12
2	**Hydrologic cycle, sources, criteria and standards of water quality:** Safe drinking water, public health significance and measurement of colour,	12

	turbidity, total solids, acidity, alkalinity, hardness, sulphate, fluoride, phosphate and different forms of nitrogen in natural and polluted water. Determination of BOD, COD and TOC. Toxic chemicals in the environment, impact of toxic chemicals on enzymes. Detergents – pollution aspects, Pesticides – pollution of surface water. Heavy metal pollution. Chemical speciation – biochemical effects of heavy metals (Hg, As, Pb, Se), carbon monoxide, nitrogen oxides, sulphur oxides and hydrocarbon. Treatment of industrial liquid wastes.	
3	**Soil Analysis:** Physical properties of soils – soil texture and soil structure. Chemical properties of soil – types of soil collides, types of clays and their swelling and adsorption properties, cation exchange capacity and its determination, acid soils – types of soil acidity, liming, measurement of pH and conductivity of soil – saline and alkaline soils, analysis of major constituents of soil – organic matter, nitrogen, sulphur, potassium and calcium. **Fuel Analysis:** Solid, liquid and gaseous fuels; ultimate and proximate analysis, heating values, grading of coal; liquid fuels; flash point, aniline point, octane number and cetane number, carbon residue; gaseous fuels; producer gas and water gas, calorific valves.	12
4	**Food Analysis:** Estimation of moisture, ash, crude protein, fat, crude fiber, carbohydrate, calcium, potassium, sodium and phosphate in foods; Analysis of common adulterants in food; Milk and milk products – alcohol test, fermentation test, dye reduction tests (methylene blue and resazurin), tests to distinguish butter and margarine, phosphate test for pasteurization, estimation of added water; Beverages – caffeine and chicory in coffee, methanol in alcoholic drinks; estimation of saccharin, coal tar dyes, aflatoxins in foods; pesticide analysis in food products – extraction and purification of sample, gas chromatography for organophosphates, thin-layer chromatography for chlorinated pesticides.	12
5	**Noise pollution:** Sources, effects, measurement, Allowed limits and control **Radioactive pollution:** Sources, effects, measurement, Allowed limits and control and storage **Soil pollution:** Classification of pollutants and their characteristics, sources, prevention and control. Environmental laws to control water and air pollution	10

References:

1. Principles of Instrumental Analysis, Skoog, Holler and Nieman, Harcourt Afca, 2001.
2. Environmental Chemistry – A.K. De, (Wiley Eastern).
3. Environmental Chemistry – S.K. Banerji, (Prentice Hall India), 1993.
4. Chemistry of Water Treatment – S. D. Faust and O. M. Aly, (Butterworths), 1983.
5. Environmental Chemistry – I. Williams, John Wiley, 2001.
6. Food Analysis – A. G. Woodman, McGrawHill, 1971.
7. Foods: Facts and Principles – Shadaksharaswamy and Manay, Wiley Eastern, 1987.
8. A Text Book of Soil Chemical Analysis – P. R. Hesse, CBS Publishers, 1994

Date Course Coordinator Subject Committee Chairperson

GEC 2: A. Chemistry for daily life

Course Title: Chemistry for daily life	Course code: 21CHE4G2AL
Total Contact Hours:28	Course Credits:02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1H
Summative Assessment Marks:30	

Course Outcomes (CO's)

1. Understanding the importance of Chemistry in daily life
2. Inform on Drug chemistry and chemistry of soaps
3. Study the use of some chemical products

At the end of the course, students will be able to

1.Know the role of Chemistry in our daily uses

2.Understand the applications of Chemistry in household activites

3.Get information about drugs and its side effects

UNIT	Description	Hours
I	**Chemistry of soaps**: Soaps, Detergents, surfactants, Diamond. Chemistry in Jewellary: Electroplating, metals and metal alloys. Chemistry of Batteries: cells, wax candals, mosquito coils and common salt. Chemistry of Cosmetics: Cosmetics formulation, perfumes, and fragrances, deodorants, Colour cosmetics, sun protections, Preservatives and its effects, Food toxicity	10
II	**Chemistry in Household** Chemistry and uses of Paints, pigments, Varnishes and coatings, cleaners, stain removears, pesticides, Fire extinguishers, cement, glasses, fertilizers Fuel Chemistry: Fuels, Introduction, fossil fuels with example, biomass energy, Energy sources: Solar energy, wind energy, tidal energy, hydal energy, nuclear energy. Chemical toxicity	10
III	**Chemistry of drugs and water** Drugs, classification, uses and side effects of pain relief drugs, antibiotics, antacids, Stimulants, ointments, syrups, tablets and capsules, Anesthetic drugs, energetic drugs. **Water Chemistry**: Importance, sources, types, underground and surface water, water contents, water born deceases, water purification	08

References

1) Chemistry in daily life by Kirpal Sing, PHI learning Pvt Ltd., 2012.
2) Engineering Chemistry by Dr. Suba Rameshm and Dr. S. Vairam, Wiley Publication, 2013
3) Drugs and pharmaceutical sciences Series, Marcel Dekkar, Vol.II, INC, New York, 2002.
4) Hand book of Fertilizer Technology By Swaminathan and Goswamy, 6th Edn., 2001.
5) Medicinal Chemistry (VEdition) by Asthoush Kar, New Age International publisher,2010.
6) Food 6 facts and principles by N. Shakuntala Manay and S. Swamy, 4th ED. New Age International, 2008.

Date Course Coordinator Subject Committee Chairperson

GEC 2: B. Water and food quality and laws

Course Title: Water and food quality and laws	Course code:21CHE4G2BL
Total Contact Hours:28	Course Credits:02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1H
Summative Assessment Marks:30	

Course Outcomes (CO's)

1. To develop theoretical aquatic chemistry basis and use the principles for the evaluation of water quality.
2. To analyse how aquatic chemistry principles can be applied in natural water resources and in treatment of drinking water and wastewater.
3. To know the chemistry and analysis of food

At the end of the course, students will be able to

1. Apply fundamental and basic knowledge to analysis of water.
2. Able to apply analytical techniques for food quality and asssesments.
3. Understanding of different laws related to protection of environment.

Unit	Description	Hours
I	**Analytics of water** Analytical aspects of water: Sources, conservation of water, impurities in water and their effects. Chemistry involved in sedimentation, coagulation and sterilization. Softening of water, lime-soda, ion-exchange process and numerical problem. Boiler troubles, causes and effects, methods of prevention. **Chemistry of water**: the water molecule, properties of pure water, fresh water and sea water. Composition of waters: surface water, ground water and sea water. Water analysis: Measurement of temperature, transparency, turbidity, determination of pH, electrical conductivity, salinity, chlorinity, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, Water quality control, Composition of natural waters, Sea water environment, Human impact on water resources, Methods of evaluation of water quality: sampling and storage, Water conservation-development of watersheds, Rain water harvesting and ground water recharge.	10
II	**Food Quality and assessment** Definition of food quality, food safety, Functions of food, Responsibility for food quality and safety, Types of adulteration, Introduction to food contaminants, Types of food contaminants, Methods of preventing food contaminants	08
III	**Regulations and Laws of water and food** The water (Pollution and control of pollution) Act, 1974, The Water (Prevention and Control of Pollution) Cess Act, 1977, Indian standards for drinking water (IS:10500, 2012). Laws & regulations, Quality management system in India, Introduction to food laws, National and International food laws, Governing bodies, Introduction to safety assessment and safety evaluation, Definition of safety assessment, Definition of safety evaluation, Laws & regulations, Quality management system in India, Laws & regulations.	10
References:		

1. Environmental Chemistry – A.K. De, (Wiley Eastern).
2. Environmental Chemistry – S.K. Banerji, (Prentice Hall India), 1993.
3. Chemistry of Water Treatment – S. D. Faust and O. M. Aly, (Butterworths), 1983.
4. Environmental Chemistry – I. Williams, John Wiley, 2001.
5. Food Analysis – A. G. Woodman, McGrawHill, 1971.
6. Foods: Facts and Principles – Shadaksharaswamy and Manay, Wiley Eastern, 1987.
7. A Text Book of Soil Chemical Analysis – P. R. Hesse, CBS Publishers, 1994

Date Course Coordinator Subject Committee Chairperson

GEC 2: C. Agro and Environmental Chemistry

Course Title: Agro and Environmental Chemistry	Course code: 21CHE4G2CL
Total Contact Hours: 28 (02 L)	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1h
Summative Assessment Marks: 30	

Course Outcomes (COs):

1. Understand the importance of safe environment
2. Study the Sources and consequences of environmental pollution
3. Gain knowledge on the composition and importance of fertilizers, pesticides for agriculture

At the end of the course, students will be able to:

1. Capable to introduce and educate people about the environment
2. Practice and adopt the skills for safe environment
3. Able to properly use agro-products

Unit	Description	Hours
1	**Agricultural products** Micronutrients and macronutrients in soil, Importance of Nutrients for plants Different nutrients for different products Fertilizers; Different types, Composition and applications, Effects of excess use of fertilizers, pollution by fertilizers Bio-based fertilizers and advantages	9
2	**Insecticides:** Composition and applications, side effects **Pesticides:** Composition and applications, side effects **Weedicides:** Composition and applications, side effects **Preservative chemicals:** Composition and side effects **Chemicals used for Ripening:** Composition, uses and side effects **Food adulteratives and contaminants:** Difference and side effects with examples Rancidity of oil	9
3	**Soil pollution:** Causes, Soil erosion, loss of fertility and remedies **Air pollution:** Sources, greenhouse effect, causes and consequences, Control and remedies **Water pollution:** Sources, Effects, Control and procedure for purification	10

References:

1. Environmental Chemistry – A.K. De, New Age International, 8th Edn., 2016
2. Environmental Chemistry – S.K. Banerji, (Prentice Hall India), 1993.
3. Chemistry of Water Treatment – S. D. Faust and O. M. Aly, (Butterworths), 1983.
4. Environmental Chemistry – I. Williams, John Wiley, 2001.
5. Food Analysis – A. G. Woodman, McGrawHill, 1971.
6. Foods: Facts and Principles – Shadaksharaswamy and Manay, Wiley Eastern, 1987.
7. A Text Book of Soil Chemical Analysis – P. R. Hesse, CBS Publishers, 1994

Date Course Coordinator Subject Committee Chairperson

DSC11P9: Spectral interpretation of data

Course Title: Spectral interpretation of data	Course code: 21CHE4C11P
Total Contact Hours: 56 (0-0-4P/week)	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 4h
Summative Assessment Marks: 30	

Course Outcomes (COs):

1. Practical approach for the interpretation of spectra of organic and inorganic compounds.
2. Train to predict the structure of compounds using spectral data

At the end of the course, students will be able to:

1. Able to interpret the spectral data which helps in the structural elucidation of compounds.
2. It strengthens the spectral analytical knowledge for Research, Industrial and teaching assignments.

SL No	List of experiments	Hours
1	a. Preparation and Spectral analysis of few complexes and organic compounds (UV- Visible, IR, TGA). b. Interpretation of Spectral data (IR, NMR,& Mass)	

References:

1. Vogel's Qualitative analysis, G Svehla and Sivasankar, Pearson press, 7th Ed 2012
2. Vogel's Textbook of Quantitative Chemical analysis, Mendham, Denney, Barnes, Thomas, Sivasankar, 6th Ed, Pearson publishers, 2009
3. A text book of quantitative inorganic analysis- A.I.Vogel, 3rd edition, 1966.
4. Vogel's text book of quantitative chemical analysis – J.Basset, R.C.Denney, G. H. Jeffere and J. Mendhom, 5th edition, 1989.
5. Vogel's Qualitative Inorganic Analysis, revised, G. Svehla, Longman, 7th Ed, 1996.
6. Practical Inorganic Chemistry, Marr and Rocket, 1972.

Date Course Coordinator Subject Committee Chairperson

Project: Project work

Course Title: Project Work	Course code: 21CHE4C1R
Total Contact Hours: 112 (0-0-8P/week)	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 4 h
Summative Assessment Marks: 70	

Course Outcomes (CO's):

1. Students are exposed to research to motivate them for research career.
2. Trained for undertaking chemistry project works

At the end of the course, students will be able to:

1. Students gain expertise in research oriented work to develop the research knowledge in the concerned field.
2. It helps them to work in group as well as develop skills.

SL No	List of experiments	Hours
1	**Project work either In-house or Research Institutes**	112

Date Course Coordinator Subject Committee Chairperson