New Courses Introduced/ courses addressing Local Needs/ courses addressing Regional Needs/ courses addressing Global Needs/ Employability Courses:

5B. List of New Courses introduced since 2019:

5B	List of New Courses introduced since 2019:		
	Course Code	*Course Title*	*Brief Description*
	CH21401CR	Advanced Inorganic Chemistry	To deliver advanced concepts in Inorganic Chemistry while also reinforcing the fundamental concepts.
	CH21402CR	Advanced Organic Chemistry	To deliver advanced concepts in Organic Chemistry while also reinforcing the fundamental concepts.
	CH21403CR	Advanced Physical Chemistry	To deliver advanced concepts in Physical Chemistry while also reinforcing the fundamental concepts.
	CH21405DCE	Lab Project in Chemistry	To Undestand and develop skills involving solving research problems in advanced research laboratories which will facilitate their journey towards a research career or industries.
	CH21002GE	Metal Ions in Living Systems	understanding of bio elements and their compounds like metalloporpyrin, metalloenzymes and their role in biological system. The students will also learn about beneficial and toxic effects of certain metals in certain forms and doses.
	CH21003OE	Medicinal Inorganic Chemistry	The students will acquire knowledge about metal based drugs and role of certain inorganic species in medicines. They will also learn about mechanism of metal ion induced toxicity, metal ion promoted carcinogenesis and medicinal uses of metal based complexes.

https://chemistry.uok.edu.in/Files/5af4c120-500f-48d4-92c2-9e0144e1cd3c/Menu/M_459b2948-c5ef-467d-8919-0aa234bf9140.pdf

6. Departmental website link in support of syllabus revisions.

1. PG Board of studies held on 16.09.2021
https://chemistry.uok.edu.in/Files/5af4c120-500f-48d4-92c2-9e0144e1cd3c/Menu/minutes3_130f3947-ce20-4d03-8daa-d438ca951b44.pdf

2. **PG Board of studies held on 30.07.2020**
https://chemistry.uok.edu.in/Files/5af4c120-500f-48d4-92c2-9e0144e1cd3c/Menu/minutes2_8da42892-6017-4bca-9b13-67eab27157d3.pdf

9B	**List of courses addressing Local Needs:**		
	Course Code	*Course Title*	*Brief Justification*
	CH21104CR	Environmental Chemistry & Analytical Monitoring.	The course leads towards the understanding of our environment, different factors which effect our environment and understanding of ways by which we can avoaid the problems related to pollotion or toxicity.
	CH21204CR	Green Chemistry	The course teaches students about an approach towards chemistry that attempts to prevent or reduce pollution. It also highlights problems associated with traditional ways of doing chemistry.

9C List of courses addressing Regional Needs:		
Course Code	*Course Title*	*Brief Justification*
CH21104CR	Environmental Chemistry & Analytical Monitoring.	The course leads towards the understanding of our environment, different factors which effect our environment and understanding of ways by which we can avoaid the problems related to pollotion or toxicity.
CH21204CR	Green Chemistry	The course teaches students about an approach towards chemistry that attempts to prevent or reduce pollution. It also highlights problems associated with traditional ways of doing chemistry.

9D	List of courses addressing Global Needs:		
	Course Code	*Course Title*	*Brief Justification*
	CH21104CR	Environmental Chemistry & Analytical Monitoring.	The course leads towards the understanding of surfactants and their applications in da-to-day life, industries, catalysis, environment and pharmaceuticals.
	CH21204CR	Green Chemistry	The course teaches students about an approach towards chemistry that attempts to prevent or reduce pollution. It also highlights problems associated with traditional ways of doing chemistry.

10B	List of Employability Courses:		
	Course Code	*Course Title*	*Brief Justification*
	CH21001GE	Surfactants and their Applications.	The course leads towards the understanding of our environment, different factors which effect our environment and understanding of ways by which we can avoaid the problems related to pollotion or toxicity.
	CH21004GE	Synthetic Polymers and their Applications	The course teaches students about chemistry of commercially important polymers and their applications in polymer industry.

Course No: CH21104CR
Title: Environmental Chemistry and Analytical Monitoring (02 Credits)

Max. Marks: 50 **Duration: 32 Contact hours**
Continuous Assessment: 10 marks **End Term Exam: 40 Marks**

Unit-I Chemistry of the Environment (16 Contact hours)

Atmosphere: Vertical profile of theatmosphere; troposphere creactivity patterns; stratospheric chemistry (Chapman mechanism and ozonedepletion).

Chemistry and control of Green house effect, Acid rain and Photochemical smog.

Hydrosphere: Factors determining composition of water bodies (acid-base, Distribution diagram), thermal-stratification, pE conceptand Pourbiaxdiagram and oxygen sag curve).

Chemistry of watert reatment: Chlorination, Ozonationand UV radiation.

Water treatment techniques: adsorption and Photo catalysis by Nanomaterials.

Unit-II Analytical Environmental Monitoring (16 Contact hours)

Analytical methods for measuring air pollutants: General aspects, Sampling and methods of analyses.Water quality parameters: Dissolved oxygen, metals (As,Cd,Hg,Pb and Se), chloride, phosphate and nitrate. Water quality standards.Continuous monitoring instruments as analytical tools for realtime monitoring of pollutants (NDIR,GC-MS, Chemiluminescence and Spectrophotometry).

Water Analysis Methods: Classical, Spectrophotometry (Chromogenic step), Electrochemical methods and Ion-chromatography.

Analytical methods for determining dissolved oxygen, BOD and COD.Choice of methods for determining trace metals (As,Cd, Hg,Pb and Se)

Books Recommended

1. Environmental Chemistry;Nigel.J.Bunce;Wurez Publishers;1991.
2. Environmental Chemistry; 2nd edn;Colin Baird; Freeman&Co;1991.
3. A Textbook of Environmental Chemistry; O.D. Tyagi & M.Mehra; Anmol Publishers; 1990.
4. Environmental Chemistry; A. K.De; WileyEastern; 1995.
5. Environmental pollution Analysis; S.M.Khopkar;WileyEastern.
6. Environmental Chemistry; S.E.Manahan (6th /7th /8th/9thEdns); LewisPublishers.
7. Environmental pollution; B.K.Sharma & H.Kaur; Goel Publishers;1996.

Course No.: CH21003OE
Title: Medicinal Inorganic Chemistry

Max. Marks: 50 **Duration: 32 Contact hours**
Continuous Assessment: 10 marks **End Term Exam: 40 Marks**

Course Outcome: On completion of the course the students should be able to:

- Understand the sources of impurities and methods to determine the impurities in inorganic pharmaceuticals and know the mechanism of metal ion induced toxicity, metal ion promoted carcinogenesis and probable mechanism of action. Treatment of essential trace and ultra-trace element deficiencies and explain the method of preparation, assay, properties, medicinal uses of metal based complexes.
- Describe the properties, storage condition and application of radiopharmaceuticals

Unit-I Medicinal Inorganic Chemistry-I (16 Contact hours)

Metal toxicity and Homeostasis: sources of metal ion poisoning. Mechanism of metal ion induced toxicity(Pb, Cd, Hg, As, and Se) Toxicity of cyanide and nitrite ions. Metal ion promoted carcinogenesis and probable mechanism of action.

Metal based Therapeutic Compounds: Conditional stability constant, Stereochemistry, Lipophilicity. HSAB theory and Plasma mobilizing index(PMI). Therapeutic index of different chelating drugs in metal ion detoxification. Limitations and hazards of Chelation therapy

Unit-II Medicinal Inorganic Chemistry-II (16 Contact hours)

Treatment of essential trace and ultra-trace element deficiencies: Manganese, Iron, Copper, Cobalt, Zinc, Molybdenum, Silicon, Nitrogen and Phosphorus. Metal salts as anti-acids, antiseptics and diuretics.

Metal complexes as drugs: Vanadium based anti-diabetic drugs, Platinum based anticancer agents(cisplatin and its derivatives), non platinum based anticancer agents and Gold based anti-arthritic compounds and their mechanisms of action. Metal Complexes as anti-virals, anti-bacterials and anti-fungals;

Metal based Diagnostic agents: Tecnetium based radiopharmaceuticals. Gadolinium based MRI imaging agents. Radio protective chelating drugs.

Books recommended:

1. Bio inorganic Chemistry -An introduction; Ochai, Allyn and Bacon;1977.
2. Inorganic Aspects of Biological and Organic Chemistry; Hanzilik; Academic;1976.
3. The Inorganic Chemistry of Biological processes; 2nd edn.; Hughes ; Wiley;1973.
4. A Text book of Medicinal aspects of Bio inorganic Chemistry; Das; CBS;1990.
5. The Biological Chemistry of Elements; Frausto de Silva; Williams; Clarenden;1991.
6. Principles of Bio inorganic Chemistry; Lippard, Berg; Univ. Science Books; 1994.
7. Inorganic Chemistry in Biology; Wilkins C &Wilkins G; Oxford;1997.
8. Metal -Ions in Biochemistry; P. K. Bhattacharya; Narosa Publishing House;2005.
9. Bio-Inorganic Chemistry; Robert W. Hay; Ellis Horwood Ltd; 1984.
10. Concepts and Models in Bio-Inorganic Chemistry; Heinz-Bernhard Kraatz; Wiley; 2006.

Course No: CH21002GE
Title: Metal Ions in Living Systems (02 Credits)

Max. Marks: 50 **Duration: 32 Contact hours**
Continuous Assessment: 10 marks **End Term Exam: 40 Marks**

Course Outcome: After studying this course, the students will an understanding

- Of bio elements and their compounds like metalloporpyrin and their role in biological system.
- Have an advanced knowledge of the role of different metalloenzymes in catalytic reactions in biological system.
- Have an understanding of beneficial and toxic effects of certain metals in certain forms and doses on life.

Unit-I Metal-ions in Bio-systems: (16 Contact hours)

Classification of metals according to their action in biological systems. Metal coordination behavior of biomolecules. Concept of essentiality, criteria and classification of essential elements. Metal Homeostasis and related diseases. Structure and Coordinating sites in biologically important ligands: Proteins, Nucleotides and Lipids. The transport mechanism: uniport, symport and antiport.

Alkali Metals: Role of Sodium and Potassium, mechanism of transport across the cell membrane. Role of Lithium in mental health.

Alkaline Earth Metals: Role of Calcium in muscle contraction and blood clotting. Role of Magnesium in chlorophyll.

Toxicity of metals: Arsenic, Mercury, Cadmium and Lead. Cyanide Toxicity, Metallothioneins.

Unit-II Biological Activity of Essential Trace Elements and Metallotherapy
(16 Contact hours)

Iron: Storage and transport through Ferritin and Transferrin. Hemoglobin and Myoglobin: Structure, iron binding sites and role of iron in oxygen transport.

Copper in Biochemical systems: Electron transfer, oxidation and oxygenation of substrates.

Zinc in Biosystems: Lewis acid catalyst, Enzyme activator in vitamin B12.

Biochemical basis of essential metal deficient diseases and their therapies (Iron, Zinc, Copper and Manganese).

Metal complex as drugs: Platinum, Rhodium and Gold complexes.

Antibacterial, Antiviral and Antifungal activities of metal complexes with probable mechanism of action.

Books Recommended

1. Bioinorganic Chemistry-A Survey; Ei- Ichiro Ochiai; Academic Press; 2008.
2. Bio inorganic Chemistry- An introduction; Ochiai; Allyn and Bacon; 1977.
3. Inorganic Biochemistry; Vol. 1&2; Eichhorn; Elsevier, 1973.
4. Inorganic Aspects of Biological and Organic Chemistry; Hanzilik; Academic Pub.; 1976.
5. The Inorganic Chemistry of Biological processes; 2nd edn. ; Hughes ; Wiley; 1973.
6. A Text book of Medicinal aspects of Bio inorganic Chemistry; Das; CBS; 1990.
7. The Biological Chemistry of Elements; Frausto de Silva; Williams; Clarenden; 1991.
8. Principles of Bio inorganic Chemistry; Lippard, Berg; Univ. Science Books; 1994.

Course No: CH21401CR
Title: Advanced Inorganic Chemistry (04 Credits)

Max. Marks: 100 **Duration: 64 Contact hours**
Continuous Assessment: 20 marks **End Term Exam: 80 Marks**

Course Outcome: After studying this course, the students will be able to

- To have an insight into structures of solid state inorganic materials like metal oxides, metal Hydroxides, MXenes, Pervoskites, MOFS, & Zeolites
- Conceptual understanding of structure- property relationship in functional inorganic materials by correlating structure with properties.
- Knowledge of standard synthesis methods of Inorganic Nanomaterials.
- Theoretical knowledge of Techniques & Methods for characterization & Analysis of Inorganic materials at Nano Level
- Understand how atomic arrangement & chemistry of inorganic material can give rise to functional properties and potential applications.

Unit-I OrganoTransition metal Compounds: (16 Contact hours)

Sigma bonded OTMC: Classification, Mechanistic pathways of kinetic instability, Routes of synthesis and reactions of σ OTMC, Decomposition Pathways: Choice, and mechanisms. Alpha, Beta hydrogen transfer reactions. Intramolecular elimination of alkane, Cyclometallation, Stability from bulky substituents, Agostic alkyls, Umpolung.

Pi-Organometallic Compounds: Comparison of **σ** and **π** OTMC, comparative bonding in Metal- alkene, alkyne, allyl, 1,3-butadiene and Cyclobutadiene Pi- systems.

Sandwich Compounds: Characteristics; Classification, Reactions and Structure and bonding of Ferrocene.

Compounds with Transition Metal to Carbon multiple bonds: Alkylidene (Schrock and Fischer) Synthesis; Structural characteristics; Nature of bonding. Reactions and their synthetic applications: Dotzreaction and Schrock's Catalyst.

Unit-II Physico Chemical behaviour of OrganoTransition metal Compounds: (16 Contact hours)

A. Fluxional Organometallic Compounds:

Characteristics; Rates of rearrangement and Techniques of study. NMR study of Fluxional behavior, Classification of Fluxional Organometallic Compounds. Mechanism of Fluxionality in compounds of η^1 Cyclopentadienyls and η^3–allyls. Stereochemical non rigidity in case of coordination numbers- 4 & 5 (cis-trans, atomic inversion, Berry Pseudorotation).

B. Catalytic processes involving OTMC: mechanism of Hydrogenation, Hydroformylation, Oxidation and Isomerization of alkenes; Olefin metathesis. Monsanto acetic acid and Reppe reaction. Fischer-Tropsch Synthesis and Ziegler Natta polymerization of alkenes. Asymmeteric, Photo redox catalysis and supported Organometallic Catalysis (brief idea)

C. Synthetic Reactions involving Organometallics:

Reactions of coordinated ligands, carbon monoxide and alkenes (Green, Mingo's rules).

Role of organo-iron compounds as synthons, Activation of small molecules: prospectus and challenges. Selected reactivities for activation of Carbon monoxide, Carbon dioxide and Alkanes. Carbon-Carbon coupling reactions (Suzuki and Heck).

Unit-III Inorganic Photochemistry; the basics (16 Contact hours)

A. Excited states: Excitation: d-d transition, charge transfer & intra-ligand transitions and selection rules. Excited states; term symbols, splitting of terms in ligand field, Orgel diagram; electrostatic description of spin allowed d-d transitions & energy level diagrams depicting excited states.

Fate of excited states; energy dissipation by radiative and non-radiative processes. Jablonoski diagram.

Molar integrated absorption intensity, natural radiative lifetime & the calculation of life times.

B. Kinetics: Photochemical laws & quantum yield. Kinetics & quantum yield of photo-physical (radiative) and photo-chemical processes. Quantum Yields of a unimolecular and bimolecular photo-chemical reaction; Quenching and Stern-Volmer plots.

C. Tools and Technique: Chemical Actinometry. Time Resolved Spectroscopies: Time correlated Single photon counting technique Time Resolved Transient Absorption Spectroscopies: Flash Photolysis

Unit-IV Electron Transfer in Excited Metal Complexes (16 Contact hours)

A. Marcus-Hush Model: Energy transfer under conditions of weak and strong interaction. Excited state electron transfer. Conditions of the excited states to be useful as redox reactants. Photochemical electron transfer, $[Ru(bipy)_3]^{2+}$;Structure, excited state properties and photo chemistry as sensitizers

B. Inorganic Photochemistry in practice: Applications, Prospects and Challenges Solar energy storage and conversion. Photovoltaic Solar cells, Perovskite Solar cells, Dye sensitized and quantum dot sensitized solar cells. Metal oxide semiconductor based photo-splitting of water.

Photochemical supra-molecular devices: devices for photo-induced energy or electron transfer, Devices for information processing, photo-chemically driven molecular machines Supramolecular photochemistry in natural systems: photosynthesis, bacterial photosynthesis and artificial photosynthesis

Books Recommended:

1. The Organometallic Chemistry of Transition Metals; 2nd and 4thedn; Robert. H . Crabtree; Wiley; 1994, 2004.
2. Fundamental Transition Metal Organometallic Chemistry; Luke hart; Brooks / Cole;1985.
3. Organometallic Chemistry; 2nd edn ; Mehrotra & Singh ; New age international2000
4. Principles and Applications of Organo Transition Metal Chemistry; Collman&
5. Finke; University Science Books;1994.
6. Principles of Organometallic Chemistry; 2nd edn.; P.Powel; Chapman & Hall;1998.
7. Metallo-Organic Chemistry; A.J.Pearson;Wiley.
8. Mechanisms of Inorganic and Organo metallic reactions; Twigg; Plenum press1983.
9. Reaction Mechanism of Inorganic and Organometallic systems; 2nd edn.; Robert .b. Jordan1998.
10. Inorganic Chemistry ; 4th edn.; Huheey ; E. Keiter& R. Keiter; Addison-Wesley;1983
11. Modern Inorganic Chemistry; William. A. Jolly; McGraw Hill;1985.
12. Inorganic Chemistry; 4* edn; Huheey; Harper & Row; 1990.
13. Chemistry of Light; Suppan, Royal Society; 1994.
14. Photochemistry, Carol J. Wayne and Richard P. Wayne; Oxford University Press; 1996.
15. Fundamentals of Photochemistry; C Rohatgi, Mukhergi; Wiley Eastern.; 1992
16. Inorganic Photochemistry; J.ChemEdu.;Vol .60, No.10,1983.
17. Applications of Inorganic Photochemistry; J. Chem. Edu.; Vol.74, No 69. 1997.
18. Principles and applications of Photochemistry, Brian,Wardle, Wiley 2009

Course No: CH21402CR
Title: Advanced Organic Chemistry (4 Credits)

Max. Marks: 100 **Duration: 64 Contact hours**
Continuous Assessment: 20 marks **End Term Exam: 80 Marks**

Course Outcome: On completion of the course the student should be able to:

- Understandvarious advanced methodologies used in the organic chemistry like asymmetric synthesis, disconnection approach and retrosynthesis.
- Understand the functions of various reagents and their applications in organic synthesis.
- Recognize the importance of the protection and deprotection of functional groups and their use in organic synthesis.

Unit I Methods in Organic Synthesis (16 Contact hours)

AsymmetricSynthesis: Nature & asymmetry, Chiral pool approach, Chiral auxiliaries and auxillary controlled stereoselection. Chiral reagents. Asymmetric formation of C-C bonds.: Asymmetric aldol, Heck and Baylis-Hillman reactions. Asymmetric hydrogenation and epoxidation of alkenes (Sharpless, Jacobsen and Shi reactions).

Stereoselectivity: Stereochemical control in six-membered rings, Stereoselectivity in bicyclic compounds.

Diastereoselectivity: Addition to carbonyl groups and stereoselective reactions of acyclic alkenes. Stereochemical reactions near a stereocenter.

Racemization & Resolution of enantiomers using chiral molecules.

Chemoselectivity: Selectivity in oxidation and reduction. Competing reactivity.

Methods of multiple bond formations: Carbon-Carbon and carbon heteroatom (N and O) bond formations with special emphasis on Metal catalysed bond formations (Ullmann, Buchwald-Hartwig, Sonogashira, Heck, Suzuki and Stille reactions).

Unit II Reagents in Organic Syntheses (16 Contact hours)

Nature and applications of following reagents in organic syntheses: DABCO, DBU, DDO, Diglyme, DMAP, MCPBA, NCS, PCC, PDC, TBHP, TBAF, Lead Tetraacetate, Osmium Tetroxide, Aluminum isopropoxide, Prevost reagent, Woodward's Reagent, $PdBaSO_4$, DDQ, DCC, SeO_2, $Tl(NO_3)_3$, $NaBH_4$, DIBAL, LAH, diisoamyborane, thexylborane, 9-BBN, $NaIO_4$,Ceric ammonium nitrite, Palladium(II)hydrotalcite, TEMPO, Ceric Ammonium nitrate(CAN), Fatezens reagent,MnO_2. Na/EtOH and Na/liq.NH_3.

UNIT-III PROTECTION AND INTERCONVERSION OF FUNCTIONAL GROUPS (16 Contact hours)

Protection of functional groups: Principle of protection of functional groups and its significance. Protection of carbon-hydrogen bonds (in terminal alkynes and Carbon-hydrogen bond of aldehydes), carbon-carbon double bonds, alcoholic and Phenolic hydroxyl groups, amino groups, carbonyl and carboxyl groups.

Functional Group Interconversion (FGI) / Transformations: Significance of Functional Group Interconversion (FGI) / Transformations in Organic synthesis. Methods of transformation of different functional groups into one another. Chemoselectivity.

Unit-IV Designing Organic Synthesis (16 Contact hours)

The disconnection approach: Introduction to synthons, their types and equivalent reagents. Reversal of Polarity(umpolung). One group, two group and Reteroelectrocyclic disconnections. Reterosynthetic Analysis involving connections and rearrangements. Guidelines for good disconnections.

One group disconnections: Reterosynthetic analysis of alcohols, amines (aliphatic and aromatic), alkenes, carbonyl compounds, carboxylic acids and their derivatives using one group disconnections and FGIs. Use of acetylenes in the syntheses of above mentioned compounds.

Two group disconnections: Reterosynthetic analysis of 1, 2- difunctional compounds (1,2 – diols), 1,3- difunctional compounds (1,3-dioxygenated compounds, α, β-unsaturated carbonyl compounds, 3-amino alcohols and 3- amino ketones), 1,4- and 1,5-difunctional compounds.

Multistep Synthesis: Application of reterosynthetic analysis in designing /achieving syntheses of some complex molecules (for example Brufen, benziodarone, Juvabione, warfarin and brevicomin(Examples other than these may also be included).

Books Recommended

1. Designing Organic Synthesis, S. Warren; Wiley; 2013.
2. Organic Synthesis- concept, methods and Starting Materials, J. Furhop and G. Penzlin;
1. Verlage VCH;1986.
2. Principles of Organic Synthesis2nd edn;. R. O. C. Norman; Chapman and Hall; 1978.
3. Advanced Organic Chemistry Part B, 5th edn.; F. A. Carey and R.J Sundberg ; Springer;
4. 2007.
5. Organic Chemistry, 10th edn;. T. W. G. Solomons and Craig B. Fryhle ; Wiley-2012.
6. Organic Chemistry; Clayden, Greeves, Warren and Wothers ; Oxford University Press-2012.
7. Organic Chemistry, David Klein; John-Wiley-2012.
8. Advanced Organic Chemistry: Reactions, Mechanism and Structure, 6lh Ed., J. March,; Wiley; 2012.
9. Organic Synthesis- The disconnection Approach; Sturat Warren; Wiley; 2013.
10. Reagent Guide, Synthetic Organic Chemistry, & Materials Chemistry, 8th Edition.
11. Modern Methods of Organic Synthesis, Carruthers W. William Caruther and Iain Coldham, 4th edition.
12. A Guide to Reagents in Organic Synthesis., S Gupta, V Gupta, R.S Dhundal, 1st edition 2015
13. Transition Metal Reagents and Catalysts: Innovations in Organic Synthesis, by Jiro Tsuji, published: 17 July 2002.
14. Organic Synthesis, Jagdamba Singh, L.D.S Yadav, 1st Edition, 2006

Course No: CH21403CR
Title: Advanced Physical Chemistry (04 Credits)

Max. Marks: 100 **Duration: 64 Contact hours**
Continuous Assessment: 20 marks **End Term Exam: 80 Marks**

Course Outcome: After learning the contents of this course, the students shall:

- appreciate the importance of catalysts for green chemistry and development of sustainable chemicals processes for industrial scale production of various chemicals/materials.
- learn as to how simple kinetic investigations and concepts acquired in the field of inorganic, organic and organometallic chemistry can be employed for the design of effective and stable catalysts for chemical transformations.
- get a knowhow of different types of catalysts, their mode of action, advantages and disadvantages, as well as their principal applications.
- understand the forces involved in the aggregation of molecules for the formation of soft matter relevant for life.
- get familiar with various soft materials formed by surfactants, polymers and block co-polymers like hydrogels, liquid crystals and microemulsions
- understand the importance of the soft matter in environmental remediation, health, diagnosis, catalysis, development of smart materials, and fabrication of non-linear optical materials.

Unit-I Catalysis-The Basics **(16 Contact hours)**

Overview of catalysis, homogeneous, heterogeneous and bio-catalysis, Replacing Stoichiometric Reactions with Catalytic Cycles, Potential functions of catalysts with examples; reaction initiation, intermediate/transition state stabilization (Sabatier's principle), reactant localization and reactant orientation, bond cleavage facilitation, electronic effect, reaction selectivity enhancement, energy and mass transfer facilitation effects of catalysts.
Kinetics of catalytic reactions. Catalyst deactivation, sintering, thermal degradation, Inhibition, poisoning.
Solvents as catalysts, solvation and its impact on reactant, product and transition state stabilization, impact of solvent on reaction rates, qualitative and semiquantitative predictions of the effect of solvents on reaction rates. Hydrophobic interactions, examples regarding facilitation of reaction kinetics and reaction selectivity via use of hydrophobic interactions.

Unit-II Applied Catalysis **(16 Contact hours)**

Catalysis by Metals: Elementary reactions on metals, mechanism of metal catalyzed reactions, Trends over the periodic table, Metal Catalysts for specific organic transformations, Blowers-Masel equation for catalyst selection.
Catalysis of Industrial processes: Mechanistic and kinetic aspects of some selected industrial process; Synthesis of methanol, Fischer-Tropsch process, Synthesis of ammonia, Oxidation of ammonia, Photocatalytic breakdown of water. Catalysis and petroleum industry**;** catalytic reforming, catalytic cracking, cracking reactions and cracking catalysts.
Industrial Bio-catalysis: High-Fructose Corn Syrup, The Mitsubishi Rayon Acrylamide Process, The BMS Paclitaxel Process, The Tosoh/DSM Aspartame Process.
An introduction to catalysis in Energy-Related Environmental Technology.

Unit-III Introduction to Soft Matter, Amphiphiles, block copolymers and microemulsions (16 Contact hours)

Introduction to Soft Matter: Constituents of soft matter, Intermolecular forces: van der waals, electrostatic forces, covalent bond, hydrogen bond and hydrophobic interactions.viscoelastic response

Amphiphiles: General overview of self-assembly of amphiphiles. Introduction and applications of stimuli-Responsive surfactants: Biosurfactants, redox, photochromic, thermoreversible, pH-sensitive, cleavable and magnetic surfactants. Lipid bilayer, hydrophobicity: entropy driven interactions, self-assembly. Physics of membranes: elasticity, Helfrich energy. Plasma membrane: architecture, composition, Fluid mosaic model, membrane channels, active pumps, function.

Block Copolymers: Introduction: classification, micellization of diblock and triblock copolymers. Introduction to pH-, thermo- and Photo-responsive block copolymers. Applications.

Microemulsions: Emulsions and microemulsions, Physicochemistry of Microemulsions: Formation, Stability, and Droplet Clustering, Percolation Phenomenon in Microemulsions. Applications of microemulsions in cosmetics and detergency, pharmaceutics, soil decontamination, enhanced oil recovery and biocatalysis.

Unit-IV Hydrogels, Langmuir Blodgett Films and Liquid crystals (16 Contact hours)

Hydrogels: Introduction, Classification of hydrogels based on type of source, crosslinking and composition. Introduction to stimuli responsive hydrogels and their types. Rheological properties of hydrogels (steady-state, oscillatory and thixotropic behavior). Characterization of hydrogels. Applications of Hydrogels in adsorption, 3D printing, shape memory materials, drug release and other biomedical applications.

Langmuir-Blodgett Films: Introduction and general preparative techniques. LB Films of various compounds (hydrocarbon, liquid crystals compounds and polymers), Applications – nonlinear optical effects, conduction, photoconductivity and sensors.

Liquid Crystals: Mesomorphism, types of liquid crystals, molecular structural requirement of mesomorphism, properties of liquid crystals, Applications – Liquid crystal displays, thermography, optical imaging and ferroelectric liquid crystals.

Books Recommended

1. Chemical Kinetics, K. J. Laidler, 3rd Edition, Pearson, 1987.
2. Chemical Kinetics and Reaction Dynamics, Paul L. Houston, Dover Publications, INC., Mineola, New York, 2001.
3. Chemical Kinetics and Dynamics, J. I. Steinfeld, J. S. Francisco, W.L. Hase, Prentice Hall, 1989
4. Chemical Kinetics and Catalysis, R.I. Masel, Wiley, 2001
5. Chemical Kinetics: From Molecular Structure to Chemical Reactivity, Luis G Arnaut, Sebastiao Jose Formosinho, Hugh Burrows, Elsevier, 2007.
6. M. J. Rosen, J. T. Kunjappu, "Surfactants and Interfacial Phenomena", John Wiley & Sons, New York, 4th Edition, 2012.
7. D. Fennell Evans, H. Wennerstrom, "The Colloidal Domain where physics, chemistry, biology and technology meet" VCH, New York, 1994.
8. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.
9. I. W. Hamley, The Physics of Block Copolymers (Oxford University Press, Oxford, 1998.
10. N. Hadijichristidis, S. Pispas and G. A. Floudas Block Copolymers (Wiley, New York, 2003).

Course No: CH21405DCE
Title: Lab Project in Chemistry (04 Credits)

Max. Marks:100 **Duration:** 3 lab session of one hour each per day

Course Outcome: On completion of the lab project the student should be able to:

- Design and setup various kinds of organic reactions in the laboratory.
- Monitor and analyze the progress of the reaction, and take appropriate measures to ensure its successful completion.
- Use catalysts, reagents and substrates keeping in mind the green chemistry practices.
- Separate the mixture of compounds by column chromatography and their analyses.
- Understand and develop the skills for extraction of compounds from plants and evaluation of their biological profile.

Course No: CH21204CR
Title: Green Chemistry (02 Credits)

Max. Marks: 50 **Duration: 32 Contact hours**
Continuous Assessment: 10 marks **End Term Exam: 40 Marks**

Course Outcome: On completion of the course, the student should be able to:

- To understand the fundamentals of green chemistry. Green Solvents, Catalysts and Green Reactions
- Understand the principles of Green Chemistry.
- Understand the basics of organic reactions with special context to green Chemistry.
- Understand need of green chemistry

Unit-I Green Chemistry-Theory (16 Contact hours)

Introduction: Need for Green Chemistry and the role of chemists. Principles of GreenChemistry. Tools of Green Chemistry: Selection of starting materials, Catalysts, Alternative Solvents, Appropriate reagents, Percentage atom utilization. Microwaves, Sonication and Visible light. Green Solvents and Reaction conditions: Supercritical fluids, Aqueous reaction conditions, Immobilized Solvents and irradiative reaction conditions.Examples of Greenmaterials, reagents and some specific reactions.

Unit-II Green Reactions (16 Contact hours)

Reactions carried under green conditions, Acyloin Condensation with Mechanism, Acyloin Condensation using Co-enzyme- Thiamine. Aldol condensation with Mechanism using green reagents -Ionic liquids, Super Critical Water and solid phase. Baeyer-Villiger Oxidation in an aqueous medium, solid phase and enzyme catalyzed. Baylis-Hillman Reaction using microwave technique, Supercritical carbon dioxide and polyethylene glycol. Benzoin Condensation under green conditions. Dakin Reaction with mechanism using Ultrasonic Irradiation. Darzen Reaction with mechanism in presence of Phase Transfer Catalyst (PTC). Green reactions involving synthesis of heterocyclic compounds (Benzofuran, Imidazopyridine, Benzothiazole -2 (3H)-one, Isocoumarins and Monobenzoylation reaction.

Books recommended

1. Green Chemistry- Environment Friendly Alternatives; Rashmi Sanghi& M. M Srivastava; Narosa; 2007.
2. Green Chemistry- An Introductory Text; IIndEdn.; Mike Lancaster; RSC; **2010.**
3. Green Chemistry- Theory and Practice; P. T. Anastas and J. C. Warner; oxford; **2000**.
4. Green Chemistry –Environmentally Benign Reactions; V.K.Ahluwalia, 2nd Edition, **2012**
5. Green Chemistry, Rashmi Sanghi and M M Srivastava; **2003** 1st Edition
6. Research papers **2012** to **2018**, (Journals recommended, Green Chemistry, Asia's Sustainable Chemistry, JOC, OL, Tetrahedron Letters, Catalysis Communications, JSCS, RSC Advances, NJC, Chemistry select, Molecular catalysis A chemical, Catalysis Letters.

Course No: CH21001GE
Title: Surfactants and their Applications (02 Credits)

Max. Marks: 50 **Duration: 32 Contact hours**
Continuous Assessment: 10 marks **End Term Exam: 40 Marks**

Course outcome: After learning the contents of this course, the students shall:

- be familiar with the types of surfactants, their aggregation behavior and structure of aggregates.
- be familiar with the applications of the surfactant systems in da-to-day life, industries, catalysis, environment and pharmaceuticals.

Unit-I Surfactant and their properties (16 contact hours)

a) ***Surfactants and Micelles :***Classification of Surfactants, Solubility of Surfactants: Kraft temperature and cloud point, Micellization of surfactants: critical micelle concentration (cmc), aggregation number, counterion binding, factors affecting cmc in aqueous media. Thermodynamics of micellization: pseudophase model and mass action models. Structure and shape of micelles: geometrical consideration of chain packing, variation of micellar size and shape with surfactant concentration.

b) ***Micellar Solubilization and Catalysis:*** Introduction, factors affecting micellar solubilization: nature of surfactant/solubilizate, effect of additive and temperature. Effect of solubilization on micellar structure, cloud point and cmc of surfactants. Solubilization of drugs into micelles and its importance in drug delivery systems and controlled release. Theoretical consideration of reactions in micellar media. Examples of micellar catalysis for hydrolysis, oxidation and reduction reactions

Unit-II Mixed Surfactant and Surfactant-polymer Systems (16 Contact hours)

a) ***Mixed Surfactant systems:*** Mixed micelle formation, mixed monolayer formation, synergism, various models of mixed micelle formation(Clint and Rubingh) and mixed monolayer formation(Rosen's model). Importance and practical applications of mixed surfactant systems.

b) ***Surfactant-Polymer Systems:***Effect of polymers on aggregation behavior of surfactants and the factors governing their interaction. Phase behavior of polymer-surfactant mixtures. Surfactant-protein interaction: introduction, Applications of surfactant-polymers systems.

Books Recommended

1. Properties of Liquids and Solutions; J.N. Murell and E. H. Boucher; John Wiley & Sons Ltd; 1982.
2. Principles of Colloid and Surface Chemistry; P.C. Heimenz; Marcel Dekker Inc; New York; 1986.
3. Surfactants and Interfacial Phenomena; M. J. Rosen; John Wiley & Sons; New York; 1989.
4. Colloid and Interface Chemistry; R. D. Vold and M. J. Vold; Addison-Wesley; 1982.
5. Surfaces, Interfaces and Colloid; D. Y. Meyer; VCH Publishers; Inc; 1991.
6. Surfactants and polymers in aqueous solution; Jonsson, Lindmann, Homberg and Kronberg; John Wiley and sons; 1998.
7. Advances in Colloid and Polymer Science; B.K.Paul&S.P.Moulik, Current Science,Vol.80,p 990-,2001; Vol.78,p 99,1998.
8. Critical Reviews in Food Science and Nutrition; John Flanagan & Harjinder Singh, ,Vol. 46, pp221-237, 2006.
9. Drug Delivery Reviews; M. J. Lawrence &G.D.Rees; Vol, 45, p 898, 2000.

Course No: CH21004GE
Title: Synthetic Polymers and their Applications (02 Credits)

Max. Marks: 50 **Duration: 32 Contact hours**
Continuous Assessment: 10 marks **End Term Exam: 40 Marks**

Course outcomes: On completion of the course, the students will acquire knowledge of:

- Basic concepts about polymers.
- Different types of mechanism involved in polymerization processes.
- Chemistry of commercially important polymers.
- Chemistry of natural rubber and polysaccharides.

Unit-I **(08 Contact hours)**

Introduction, Definition, Classification based on source, Structure, Synthesis and Forces of attraction. Thermosetting and Thermosensitive plastics, Types of Monomers,Homopolymers and Copolymers.

Unit-II **(08 Contact hours)**

Polymerisation processes, Addition polymerization, Free radical, Cationic, Anionic mechanism of addition polymerization Initiators, Inhibitors and Propagators. Stereochemical control of polymerization- Zeiglar Natta catalysts, Poly condensation; Polymerisation.

Unit-III **(08 Contact hours)**

Commercially important polymers: Polyesters, Polycarbonates, Polyamides, Polyurethanes, Poly sulphides, Resins: Phenol-formaldehyde and Melamine-formaldehyde resins. Conducting Organic Polymer (elementary idea), Biodegradable polymers

Unit-IV **(08 Contact hours)**

Natural polymers*:* Rubber, Vulcanization,
Polysaccharides: Cellulose, Amylopectin and Starch, Proteins; Wool, Silk and Collagen; Regenerated properties.

Books Recommended

1. Organic chemists: Francis . A. Carey, Robert M. Giuliano. 8th ed. Tata Mc Graw Hill. 2010
2. Polymer chemistry- An introduction. Mallolin. P. Steven, 2nd ed. Oxford University. 1998
3. Organic chemistry: L. G. Wade, Tr. Maya Shankar Singh. 6th ed., 2005, Pearson.
4. Introduction to polymers: 2nd ed. R.J. Young and P.A. Lovell. Chapman and Hill
5. Organic chemistry: David Klein; Willey 2012 .