M.Sc. Chemistry

Employability **Entrepreneurship** **Skill Development**

Name Of The Programme	Course Code	Title Of The Course	Employability	Entrepreneurship	Skill development
M.Sc., Chemistry	PQE3	ECIII-Green Chemistry	✓		
	PQE2	ECII-Industrial Chemistry		✓	
	PQE4	ECIV-Applied Chemistry		✓	
	PQE5	EC V- Analytical Techniques			✓
	PQM	CC XIII- Recent Trends in Chemistry			✓
	PQE1	EC I- Non- Conventional Energy Sources			✓
	MQB	Organic chemistry-I	✓		
	MQA	Inorganic chemistry-I	✓		
	PGQE2	Bioinorganic chemistry	✓		
	PGQE4	Forensic science	✓		
	PGQE3	Molecular modeling and drug design	✓		
	PGQE5	Petrol and petrochemical products	✓		

Semester-III / Elective Course- II	**GREEN CHEMISTRY**	**CourseCode: PQE3**
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• To study the basic principles and alternative materials of sustainable green chemistry. • To learn the synthesis of ionic liquids and phase transfer catalysis. • To impart depth knowledge in supported catalysis and biocatalysis. • To learn the alternative synthesis reagent and reaction condition of green chemistry.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**INTRODUCTION TO GREEN CHEMISTRY** Green chemistry – relevance and goals, Anastas, twelve principles of green chemistr Tools of green chemistry, alternative starting materials, reagent, catalysts, solvent, a processes with suitable examples.	**(18 Hrs)**
Unit - II	**MICROWAVE ACTIVATION ORGANIC SYNTHESIS (MAOS)** Microwave activation – advantage of microwave exposure – specific effects of microwa reactions – solid supports reactions – Functional group transformations – condensations – oxidations-reductions reactions – multi-component reactions.	**(18 Hrs)**

Unit- III	**IONIC LIQUIDS AND PTC** Introduction – synthesis of ionic liquids – physical properties – applications in alk hydroformylations – expoxidations – synthesis of ethers – Friedel craft reactions – Die reactions – knoevengel condensations – Wittig reactions – Phase transfer catalyst –s applications.	**(18 Hrs)**
Unit - IV	**SUPPORTEDCATALYSTS AND BIO-CATALYSTS FORGREENCHEMISTRY** Introduction – the concept of atom economy – supported metal catalysts – mesoporous sil use of biocatalysts for green chemistry – modified bio catalysts – fermentat biotransformations - fine chemicals by microbial fermentations – vitamins and amin Baker's yeast mediated bio-transformations – bio-catalyst mediated Baeyer- Villiger re Microbialpolyestersynthesis.	**(18 Hrs)**
Unit - V	**ALTERNATIVE SYNTHESIS,REAGENTS AND REACTION CONDITIONS** A photochemical alternative to Friedel-crafts reactions – Dimethyl carbonate as a methylatingagent – the design and applications of green oxidants- super critical carbondioxideforsyntheticchemistry	**(18 Hrs)**

Text books:

1. V.K.Ahluwalia, Green Chemistry – Environmentally benign reactions-,AneBooks India (publisher).(2006).

References Books:

1. Paul T.Anastas& Tracy C.Williamson, Green chemistry – Designing chemist environment –SecondEdition(1998).
2. Paul T.Anastas&Tracy C.Williamson.Green chemistry –Frontiers in benign c synthesis andprocesses-Oxford University Press(1998).
3. Rashmi Sanghi&M.M.Srivastava,Green chemistry – Environment friendly lternatives- NaroraPublishingHouse,(2003)

e- Resources

1.https://www.ncbi.nlm.nih.gov2.https://en.m.wikipedia.org

Course Outcomes:

After successfully completing this course, students will be able to:

CO1: Explain Green chemistry and sustainability which relates to problems ofsocietalconcern.

CO2: Describe Green chemistry and sustainability developments that affect society, theenvironment and economic development.

CO3: Analyze a process and identify parameters that make environmentallyfriendly/sustainable/green.

CO4: Integrate, synthesize, and apply knowledge of the relationship betweenscienceand technology and societal issues in both focused and broad interdisciplinary contexts.

CO5: Demonstrate the ability to effectively communicate to others the conceptslearnedin the course.

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester- I / Core Course-I	**INORGANIC CHEMISTRY I**	**Course Code: MQA**
Instruction Hours: 6	**Credits: 6**	**Exam Hours: 3**
Internal Marks :25	External Marks :75	**Total Marks: 100**

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• To learn the structure of crystal lattice. • To study the concepts of different types of bonds. • To understand the concept of kinetics of reaction mechanism. • To know about the concept of Acids and bases. • To acquire knowledge about nuclear reactions.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**IONIC BOND AND CRYSTAL STRUCTURE** Radius ratio rules-calculation of limiting ratio rules of Coordination number 3 to 6. Classification of ionic Radius Ratio rules – Calculation of some limiting radius ratio values for Coordination number.3 (planar Triangle), Coordination number.4 (tetrahedral), Coordination number.6 (octahedral).Classification of Ionic structures – AX(ZnS, NaCl, CsCl,), AX_2 (CaF_2, TiO_2, CdI_2) Lattice energy- Born Lande equation –Kapustinski equation-High Tc superconductors- Solidstate reactions- Type.	**(18 Hrs)**
Unit - II	**BASICS OF CO-ORDINATION CHEMISTRY** Theories, nomenclature of mono and polynuclear complexes. Crystal field theory – shapes of d orbitals. Splitting of d orbitals in octahedral	**(18 Hrs)**

	symmetry – CFSE – strong field and weak field splitting – calculation of CFSE for dn system. Splitting in tetrahedral symmetry – only weak field splitting – reasons. Tetragonal symmetry – difference betweentetrahedral and tetragonal symmetry. Jahn – Teller distortion – splitting pattern in trigonal, square planar, trigonal bipyramidal, square pyramidal, cubic symmetries. Factors affecting the magnitude of splitting (10 Dq), Oxidation state of the ligands, nature of the ligands – spectrochemical studies. Jorgensens relation. Evidences for CFT. M.O. Theory – Octahedral, tetrahedral and square planar complexes. Pi bonding and M.O. theory – ligands having filled and empty pi bonds – effects on 10 Dq. Evidences for pi bonding – Nephelauxetic effect – angular overlap model.	
Unit- III	**REACTION MECHANISM IN COORDINATION COMPLEXES** Kinetics and mechanism of reactions in solution – labile and inert complexes – ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis,base hydrolysis and anation reactions. Trans effect – theory and applications – electron transfer reactions – electron exchange reactions – complementary and non-complementary types – inner sphere and outer sphere processes – application of electron transfer reactions in inorganic complexes –isomerisation and racemisation reactions of complexes. Molecular rearrangements of four- and six-coordinate complexes – inter conversion of stereoisomers– reactions of coordinated ligands – template effect and its applications for the synthesis of macrocyclic ligands – unique properties.	**(18 Hrs)**
Unit - IV	**ACIDS AND BASES** Usanowich concept-generalised acid base concept-steric and solvation effect- measure of acid base strength. HSAB principle-classification of acid and base as hard and soft-E and C parameters-theoretical base of	**(18 Hrs)**

	hardness and softness. 4:2 Non-aqueous solvent-Differentiating and Leveling Solvents-solvation number- medium effect-pH measurements in non-aqueous media-liquid ammonia, SO_2, H_2SO_4, HCN, HF as solvents.	
Unit - V	**NUCLEAR CHEMISTRY** Nuclear properties - modes of radioactive decay. Alpha and beta decay, orbital electron capture, nuclear isomerism, internal conversion**.** Detection and determination of radio activity. Cloud chamber, nuclear emulsion, Geiger Muller counter, scintillation and cherankov counters Nuclear reaction -Transmission, fission, fusion, spallation and fragmentation reactions. Neutron sources - neutron activation and isotopic dilution analysis.	**(18 Hrs)**
Unit VI Self Study	Basic concepts of organometallic compounds- metal metal bonds, theories of metal ligand, metal carbonyls and metal nitrosyls-synthesis and structure.	

Text Book:

1. J.E. Huheey, Inorganic chemistry,Pearson Education Publisher,4th edn,2016.
2. M.C.Day, J.Selbin &H.H.Sisler, Theoretical Inorganic chemistry, Literary Licensing Publisher,2012.

Reference Book:

1. J.D. Lee, A new concise Inorganic chemistry, Wiley India Publishers, 4th edition, 2015.
2. Geoffrey.A.Lawrance, Introduction of coordination chemistry, John Wiley & Sons Publishers, 1st edition,2010.
3. R.K.Sharma, Inorganic Reaction Mechanism: Discovery Publishing House, New Delhi, 2011.
4. ArunBahl, B.S.Bahl, G.D.Tuli, Essential of Physical chemistry,S.Chand Publishers, 1stmulticolour revised edition2008.
5. John.R.Lamarash, Introduction to Nuclear Reactor Theory, Addison-Wesley Publishers-3rd edition 2014.

Web - Resources:

www.science direct.com

https://sites.google.com

Course Outcomes:

On completion of the Course, Students should be able to

CO: 1 Understand the address of the ionic bond and know the types of ionic structure.

CO: 2 Determine the stability of complexes and to apply various reaction of coordination compound

CO: 3 Apply CFSE for coordination compounds

CO: 4 Apply various concepts of acids and bases to interpret the types of materials.

CO :5 Use various radioactive detectors and apply various nuclear reactions.

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	PO					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	M	M	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	M	S	S	M	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester- I / Core Course-II	ORGANIC CHEMISTRY – I	Course Code: MQB
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks - 75	Total Marks: 100

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• To understand the criteria for aromaticity and elimination reactions. • To introduce advanced level study in stereochemistry • To learn the classification, structure of steroids • To study about the rearrangements • To introduce retro synthetic analysis and modern synthetic reagents	
UNIT	**CONTENT**	**HOURS**
Unit -I	**AROMATICITY** Elements of aromaticity – Huckel's and Craig's rule – effects of aromaticity on bond lengths – ring currents. Nonbenzenoid aromatic compounds – aromatic character in three, five, seven and eight membered rings – anti aromaticity – systems with 2, 4, 8 and 10 electron systems. Annulenes and syndones – alternantand non – alternant hydrocarbons**.** Elimination reactions**:** E1, E2, E1CB and Ei – mechanisms – stereochemistry of eliminations – Hoffman and saytzeff rules – Competition between elimination and substitution reactions – Chugaev reaction dehydration of alcohols, dehydrohalogenation – Hoffman degradation. Cope elimination – Bredt's rule.	**(18 Hrs)**

Unit - II	**ORGANIC STEREOCHEMISTRY** Configurational nomenclature – D and L nomenclature R-S nomenclature of acylic and cyclic chiral compounds – stereochemistry of allenes, spiranes, biphenyls (atropisomerism), Stereochemistry of Ansa compounds, cyclophanes. Definition of terms prochirality. Enantiotopic and diastereotopic group –asymmetric synthesis – Cram's rule Dynamic strereochemistry: Quantitative correlation between conformation and reactivity, Winstein-Eliel equation, Curtin – Hammett principle. Conformation, reactivity and mechanisms of cyclic systems-saponification of an ester, esterification of an alcohol, chromic acid oxidation of 2,2-aminocyclohexanol- stereospecific, stereoselective,diastereoselective & Enantioselective reaction	**(18 Hrs)**
Unit- III	**STEROIDS** Classification – structural elucidation of cholesterol (synthesis not required) – structural elucidation and synthesis of vitamin D – estrone, progesterone,equilenin,and androsterone.	**(18 Hrs)**
Unit - IV	**MOLECULAR REARRANGEMENTS & ITS MECHANISMS** C=C Rearrangements: Wagner Meerwein, Dienone – phenol, Stevens, Wittig, Favorski rearrangements. C=N Rearrangements: Wolf, Lossen, Schmidt rearrangements. C=O Rearrangements: Bayer – Villiger rearrangement Heterocyclic compounds: Synthesis and reactions of azoles – pyrazole, imidazole, oxazole and thiazole – synthesis and reactions of oxazine, pyridazine, pyrimidine and pyrazine.	**(18 Hrs)**
Unit - V	**MODERN SYNTHETIC METHODOLOGY** Retrosynthetic analysis or Synthon approach. -- An introduction to reterosynthesis - synthon – synthetic equivalent – target molecule,	**(18 Hrs)**

	functional group interconversion. Disconnection approach-One group disconnections- Disconnection of alcohols,olefins, ketones. Two group disconnections – 1,3- dioxygenated skeletons-1,5-dicarbonyl compounds .Illogical two group disconnections strategy	

Text book:

1. P.S Kalsi organic reactions & mechanism 2nd edition new age internationalpublishers 2002,
2. J. March, Advanced Organic Chemistry, 4th edition john wiley and sons, NewYork 2006.
3. Starkey, L., S., Introduction to Strategies for Organic Synthesis, Wiley, 2012

Reference Book:

1. Carey B.F.A Sundberg, Advanced Organic Chemistry Part A & B Springer 5thedition,2007.
2. D. Nasipuri, Stereochemistry of Organic Compounds-Principles and Applications, 4n Academic Science Publisher, 2012
3. O.P.Agarwal, Chemistry of organic natural products Vol. I and Vol. II, GoelPublications, 2014.
4. Sanyal&Sanyal,Rearrangement and reagents, BharatiBhawan publishers and distributors4thedition ,2003.
5. Willis, C. L., Wills, M., Organic Synthesis, Oxford ChemistryPrimers, 31, Oxford SciencePublications, 1996.

Web - Resources:

https://www.quora.com

https://www.rsc.org

https://www.e-booksdirectory.com

Course outcomes:

On completion of the Course, Students should be able to

CO1: To understand the concept of aromaticity and stability of molecules.

CO2: Gain the knowledge in the field of stereochemistry.

CO3: To understand the synthesis and structure of steroids

CO4: Studying the rearrangement will stimulate the knowledge for preparing chemical compounds.

CO5: To introduce synthetic methodology of preparation of compounds.

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	M	S	M	S	S	S	S	S	S
CO2	S	S	S	S	M	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S

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W- Weakly Correlated

N- No Correlation

Semester-III / Elective Course- II	**BIO INORGANIC CHEMISTRY**	**Course Code**
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• Gain knowledge about bio inorganic molecules and their role in biology. • Understand the control and assembly of bio minerals. • Study the role of metal ions in biological process. • Learn chemotherapy with on-essential elements. • Introduce advanced topics in bioinorganic chemistry.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**GENERAL PRINCIPLES OF BIO INORGANIC CHEMISTRY** Occurrence and availability of Inorganic elements – Biological function of inorganic elements – Biological ligands for metal ion coordination of proteins and Nucleic acids as ligands. Other metal binding molecules like prosthetic groups, coenzyme B_{12}, bleomycin and siderophores. Relevance of Model Compounds – Communication roles for metals in biology – metal ion transport and storage.	**(18 Hrs)**
Unit - II	**BIO MINERALISATION** Control and assembly of advanced materials in Biology – Nucleation and crystal growth various bio minerals – calcium phosphate – calcium	**(18 Hrs)**

	carbonate – Amorphous silica, iron bio minerals – strontium and barium sulphate. BIO CHEMICAL BEHAVIOUR OF INORGANIC RADIO NUCLIDES Radiation risks and Medical benefits–Natural and Man made radio isotopes. Bio inorganic chemistry of Radio pharmaceuticals – Technetium.	
Unit- III	**FUNCTION AND TRANSPORT OF ALKALI AND ALKALINE EARTH METALION** Characterization of K^+,Na^+,Ca^{2+},and Mg^{2+}- complexes of alkali and alkal in earth metal ions with macromolecules – Ion channels–Ion pumps. Catalysis and regulation of bio energetic processes by the Alkaline Earth Metalions Mg^{2+} and Ca^{2+}.	**(18 Hrs)**
Unit - IV	**CHEMOTHERAPY** Chemotherapy with compounds of certain non - essential elements. Platinum complexes in cancer therapy – Cis platin and its mode of action – Cytotoxic compounds of other metals – Gold containing drugs as anti - rheumaticagents and their mode of action– Lithium in Pschyco pharmocological drugs.	**(18 Hrs)**
Unit - V	**MEDICINAL BIO INORGANIC CHEMISTRY** Bio inorganic chemistry of essentially toxic metals. Lead, Cadmium, Mercury, Aluminium, Chromium, Iron, Plutonium, Detoxification by metal chelation. Drug sthat act by binding at the metalsites of metalloenzymes**.**	**(18 Hrs)**

Text Book:

1. D.E.Fenton,Bio coordination Chemistry, Oxford Chemistry, Primer Series, Oxford Science Publications,Oxford,1995.
2. G.L.Zubay, Biochemistry, WMC Brown publishers,Chicago,1998.

Reference Books:

1. Ivano Bartini, Harry B.Gray Stephen J.Lippard, Joan Deverstonealentine - Bio Inorganic Chemistry–Viva Book spvtltd.
2. AjayKumar Bhagi, G.R.Chatwal, Bio Inorganic Chemistry and Supra Molecular Chemistry–

Himalaya Publishing House.

Web - Resources:

1.https://www.hindawi.com

2.https://www.ionicviper.org

Course Outcomes:

On completion of the course the learner will be able

CO 1: Understand the effect of various ligand field strengths on d-metal ions and find out ground state terms with their energies, microstates, degeneracy and microstate table for different transition metal ions and complexes.

CO 2: Understand electronic spectra of complexes w.r.t. spin and orbital selection rules, various transitions, charge transfer spectra and luminescence spectra with LASER application.

CO 3: Know the magnetic properties of complexes and understand spin-only and effective magnetic moments, Zeeman effect, properties of complexes with A, E, and T terms.

CO 4: Understand of Bioinorganic Chemistry: Use of metals in biological systems, various aspects of coordination chemistry related to bioinorganic research, metallobiopolymers, their structure,function, role of metal ion, etc.

CO 5: Get the knowledge of Biochemistry of metals like Na, K, Fe, Ca and Mn.

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	PO					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester-III / Elective Course- III	Molecular Modeling and Drug Design	Course Code
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• Gain knowledge and modern approaches used in molecular modeling. • Identify and design molecules for new medication. • Acquire the capacity to apply the ideas of quantum and molecular mechanics, hydrogen bonding and its significance in the application of drug development. • Learn the drug design and pharmacokinetics. • Study the structure, properties and mechanism of action of drugs.	
UNIT	**CONTENT**	**HOURS**
Unit - I	**Molecular Modeling in Drug Discovery** Drug discovery process, Role of Bioinformatics in drug design, Methods of computer aided drug design, ligand design methods, drug design approaches, Target identification and validation, lead optimization and validation, Structure and ligand based drug design ,modeling of target - small molecule interactions, Molecular simulations. Protein Modelling.	**(18 Hrs)**
Unit - II	**Quantum Mechanics and Molecular Mechanics** Features of molecular mechanics, force fields; Bond structure and bending angles – electrostatic, van derWaals and non – bonded interactions, hydrogen bonding in molecular mechanics; Derivatives of molecular mechanics energy function; Application of energy minimization.	**(18 Hrs)**
Unit- III	**Nomenclature and Mechanism of Drugs** Introduction- Study of drugs- Important terminologies in pharmaceutical chemistry-Classification and nomenclature of drugs- Nomenclature of some heterocyclic systems- **Mechanism**	**(18 Hrs)**

	of action of drugs – metabolism of drugs - Absorption of drugs – Assay of drugs.	
Unit - IV	**Drug Design and Pharmacokinetics** Drug design: Variation of substituents, chain extension , ring expansions/contractions, ring variations ringfusions, isosteres, rigidification of the structure, conformational blockers. Pharmacokinetics: Pharmacokinetics issues in drug design- Solubility and membrane permeability- Resistant to hydrolysis and metabolism- Targeting drugs – Reducing toxicity – Prodrugs .- Methods of administration - Formulation.	**(18 Hrs)**
Unit - V	**Application of Drugs for Treatment** Structure, properties and mechanism of action of the following Antibacterial drugs – Sulpha drugs: Sulphanilamide, sulphadiazine, sulphapyridine. Antibiotics- Chloramphenical, Penicillin, Streptomycin,Antiseptics and disinfectants: Phenol and its derivatives, Halogen compounds and organicmolecules. Analgesics: Morphine, Heroin, Pethidine, Morphine. Anticonvulsant: Barbiturates, Oxazolindiones. Diabetes: Control of diabetes, Insulin. Cancer and anti neo plasticdrugs :Allylatingagents, Antimetabolites, Plantproducts. Cardiovascular drugs: Antiarrhythemic drugs, Antihypertension drugs.	**(18 Hrs)**

Text Book:

1. A.R.Leach- Molecular Modeling Principles and Application, 2nd edition, Longman Publications,1996.
2. D.Baxivanis and Foulette - Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiely Indian Edition,2001.

Reference Books:

1.T K Attwood, DJ Parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition,

2.Anand Solomon, Introduction to Cheminformatics 3.Lersenetal,Textbook of Drug design and Discovery, 4th Edition, London and Newyork, 2004.

Web - Resources:

1.https://www.taylofrancis.com

2. https://www.researchgate.net

Course Outcomes:

On completion of the course the learner will be able

CO 1: Identify the steps for designing new drugs, target identification and validation

CO 2: Acquire the capacity to apply the ideas of atomic displacement, Quantum and Molecular Mechanics, bonded interactions, hydrogen bondings and its significance in the application of drug development

CO 3: Execute protein structure prediction and would be able to predict the derivatives of the molecular mechanics energy function

CO 4: Understand the Molecular Dynamics simulation using the simple models, continuous potentialsat constant temperature and pressure

CO 5: Capable to present the docking strategies based on the ligand, receptor and denovo ligand design.

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	**PO3**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester-III / Elective Course- IV	Forensic science	Course Code
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• Study about contamination of food, detection and anti dote for food poison • Introduce advanced topics in Forensic Science • Learn about crime detection • Detect forgery and counter feting • Understand the misuse of drugs	
UNIT	**CONTENT**	**HOURS**
Unit -I	**Transportation** Drunken driving: breath analyzer for ethanol. Incendiary and timed bombs in road and rail way tracks. Defusing live bombs. Hit-and-go traffic accidents: paint analysis by AAS. Soil of toxic and corrosive chemicals (e.g., conc.acids) from tankers.	**(18 Hrs)**
Unit - II	**Crime detection** Accidental explosions during manufacture of matches and fire works. Human bombs, possible explosive (gelatin sticks, RDX). Metal detector devices and other security measures for VVIP. Composition of bullets and detection of powder burns. Scene of crime: finger prints & their matching using computer records. Smell tracks & police dogs. Analysis of blood & other body fluid	**(18 Hrs)**

	sinrape cases. Typing of blood. DNA finger printing or tissue identification in dismembered bodies. Blood stain son clothing. Cranial analysis (head and teeth).	
Unit- III	**Forgery & counter feiting** Detecting forgery in blank cheques / drafts and educational records (mark lists, Certificate) using UV light . Alloy analysis using AAS to detect counterfeit coins .Checking silver line water mark in currency notes. Jewellery : Detection of gold purity in 22carat ornaments, detecting gold plated jewels	**(18 Hrs)**
Unit - IV	**Medical aspects aids:** cause & prevention. Misuse of scheduled drugs. Burns & their treatment by plastic surgery. Metabolite analysis using mass spectrum–gas chromatography. Detecting steroid consumption among athletes and racehorses.	**(18 Hrs)**
Unit - V	**Transportation** Drunken driving: breath analyzer for ethanol. Incendiary and timed bombs in road and rail way tracks. Defusing live bombs. Hit-and-go traffic accidents: paint analysis by AAS. Soil of toxic and corrosive chemicals (e.g., conc.acids) from tankers.	**(18 Hrs)**

Text Book:

1. Subrahmanyam BV,Perkins Textbook of Medical Jurisprudence forensic medicine and toxicology,8th
   Edition 2019.
2. Ignatius PC, Textbook of forensic medicine and toxicology, 4thEdition2019.
3. PillayVV, NACPFMT'S Practical Medicolegal manual(vol-1)1stEdition2019.

Reference Books:

1. T.H James Forensic Sciences, Stanley Thornes Ltd.
2. Richard, Criminalistics- An introduction to Forensic Science, 8th Edition, So festein, prentice hall.

Web- Resources:

https://www.forensicresources.org2.https://www.all-about-forensic-resources.com

Course Outcomes:

On completion of the course the learner will be able

CO 1: To emphasize the importance of scientific methods in crime detection.

CO 2: To disseminate information on the advancements in the field of forensic science.

CO 3: To highlight the importance of forensic science for perseverance of the society.

CO 4: To review the steps necessary for achieving highest excellence in forensic science.

CO 5: To generate talented human resource, commiserating with latest requirements of forensic science.

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	PO					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester-IV / Elective Course- VI	**Petrol and petrochemical products**	**Course Code**
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• Understand the chemistry of crude oil. • Learn the properties of petroleum products • Study the chemistry of natural gas refining, distillation and separation technique. • Get knowledge about the various conversion processes in petroleum products. • Know the manufacture methods of Lube oil, Petroleum Waxes, bituments.	
UNIT	**CONTENT**	**HOURS**
Unit-I	**Crude oil** Petroleum exploration production and refining of crude oils. Crude oils: Chemistry and composition (characteristics and constituents of crude oils).	**(18 Hrs)**
Unit-II	**Properties of petroleum products** Quality control of Petroleum products- Classification of laboratory tests, distillation, vapour pressure, flash and fire points, octane number, performance number, cetane number ,aniline point, viscosity index, calorific value, smoke point, char value, viscosity, viscosity index, penetration tests, cloud and pour points, drop point of grease, melting and settling points of wax, softening point of bitumen, induction period of gasoline, thermal stability of jet fuels, gum content, Total sulphur, Acidity and alkalinity, Copper strip corrosion test, Silver – strip colour	**(18 Hrs)**

	test for ATF, Ash, Carbon residue (conradson method, Rams bottom method) colour, Density and specific gravity, refractive index of hydrocarbon liquids, Water Separation Index Modified (WSIM),ductility.	
Unit-III	**Natural gas & conversion process** Petroleum Products- Composition, properties & specification of LPG, Naphtha, motorspirit. Kerosene, Aviation turbine fuels, diesel fuel soils, petroleum hydrocarbon solvents, Lubricating oils (automotive engine oils, Industrial lubricating oils electrical insulating oils, jute batching oils, white oils, steam turbine oils, metal working oils etc.) Petroleum waxes bituments, Petroleum coke. Crude oil distillation–Desalting of crude oils, atmospheric distillation of crude oil, vacuum distillation of atmospheric residue. Thermal conversion process – Thermal cracking reactions, thermal cracking, vis breaking(conventional vis breaking and soaker vis breaking) coking (delayed coking, fluidcoking,flexicoking),calcinations of greencoke	**(18 Hrs)**
Unit-IV	**Catalytic conversion** Catalytic conversion process–Fluid catalytic cracking, catalytic reforming, hydro cracking catalytic alkylation, catalytic isomerisation, catalytic polymerization. Finishing Process–Hydrogen sulphide removal processes, sulphur conversion processes, sweetening processes(caustic treatment, solutizer process, doctor treating process,copper chloride weetening, Hypochlorite sweetening, air and inhibitor treating process, merox processes, sulphuric acid treatment, clay treatment, solvent extraction processes(edeleanu process, udex process, sulfolane process), hydro treating processes.	**(18 Hrs)**
Unit-V	**Lube oil & bitument** Lube oil Manufacturing process – Evalution of crude oils for lube oil base stocks, vacuum distillation, solvent deasphalting solvent extraction of lube oil fractions (furfural, NMP and Phenol), solvent dewaxing, hydro finshing. Manufacture of petroleum waxes (wax sweating, solvent	**(18 Hrs)**

	deoiling) Manufacture of bituments– Selection of crude oil, methods of manufacture of bituments. (distillation, solvent).	

Text Book:

1. T.Pradeep " Nanotheessentials– understanding Nano Science and NanoTechnology "TataMcGraw -hill publishingLtd.,NewDelhi, 2007.
2. M.M. Srivatsava, Rashmi Sangi "Chemistry for Green Environment, Narosa publishing House, NewDelhi2005.

Reference Books:

1. P. T. Anastas and J. C. Warner, Green chemistry Theory and Practice; Oxford University Press, NewYork, 2005.
2. J.W. Steed& J.L.Atwood, Supramolecula rChemistry, Wiley,2000.
3. Frank Jenson, Introduction to Computational Chemistry, Wiley,Newyork, 1999.

Web - Resources:

1. https://www.understandingnano.com
2. https://webs.iiitd.edu.in

Course Outcomes:

On completion of the course the learner will be able

CO 1: Learn the control of production Chemicals for the oil & gas industry

CO 2: Understand hydrogen carbon… terminology, definitions, classifications, properties and chemical composition and associated metals, and including natural gas properties

CO 3: Acquire knowledge about the chemistry of the petroleum process as it relates to applications

CO 4: Know the equipment and procedures for evaluating drilling fluid performance

CO 5: Gain knowledge about clay mineralogy and the colloid chemistry of drilling fluids

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	PO					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

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N- No Correlation

ENTREPRENERUSHIP

Semester- IV /Elective course-IV	**APPLIED CHEMISTRY**	**Course Code: PQE4**
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks - 25	External Marks- 40	Total Marks: 100

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• Study about quality control measurements in industries. • Understand the textile processing and dyeing. • Learn the classification and application of paint. • Get awareness about the importance of wealth from waste. • Know the mechanism of drug action and metabolism of drugs.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**QUALITY CONTROL MEASUREMENTS** Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium ,sodium and Phosphate – Food adulteration – common adulterants in food, contamination of food stuffs Microscopic examination of foods for adulterants – Pesticides analysis in food products – analysis of toxic metals in food (Hg,Cd,Co,Sn and Cr) – Determination of iodine, Saponification and acid value of an oil- Food standards- ISI and Agmark**.**	**(18 Hrs)**

Unit - II	**TEXTILE PROCESSING** Pretreatment : Sizing, Desizing- acid method, Scouring- kier boiling method, Bleaching – hypochlorite method, Mercerization, fastness properties – washing, rubbing and light fastness Dyeing: Dye fibre bond, % of shade, M: L ratio, % of exhaustion, equilibrium absorption, effect of electrolyte. Reactive dye - principles of dyeing, Polyester dyes - carrier dyeing - mechanism and high temperature is dyeing. Mordant dyes– principles– specific examples. Acid dyes- dyeing mechanism–role of electrolyte and dye bath assistants. Vat dyes– vatting–dyeing–oxidation and after treatment.	**(18 Hrs)**
Unit- III	**PAINT** Paint – definitions – ingredients and their role – terminology – emulsion, lacquer. Enamel – pot life, shelf life –varnish– thixotropy–classification of paints based on drying mechanism-undercoats–Pigments–classification (organic &Inorganic)– functions–properties such a shiding power, light fastness, particle size and shape Solvents used for paints– flashpoint. **Vehicles:** Oil– drying mechanism, Description of Alkyd, Epoxy, Poly metyl methacrylate, Urea formaldehyde, Melamine formaldehyde, urethane resins. Additives – Anti skinning agents, Powder coating, Solventless finish.	**(18 Hrs)**
Unit - IV	**WEALTH FROM WASTE (RECYCLING)** Introduction– Recycling Technique – Construction materials from waste– Medicines from agricultural waste- liquid fuels from agricultural –Urban waste and bagasse for electricity Agricultural waste for biomass into cheap and efficient fuel– Bacteria for paper making– Waste into objects of daily use fuel- How to use garbage to generate power.	**(18 Hrs)**

Unit - V	**MEDICINAL CHEMISTRY** Mechanism of drug action and Metabolism of Drugs: Mechanism of action – Drug Receptors and Biological responses– Mechanism of different types of drug action – Metabolism of drugs – Chemical pathway of drug metabolism absorption of drugs – Routes of administration - factors affect absorption – Digestion and absorption of protein – Digestion of fat.	**(18 Hrs)**

Text Books:

1.B. K. Sharma, H. Karur, Environmental chemistry –- GoelpublishingHouse,Meerut.

2.B. K. Sharma – Industrial chemistry - Goel publishingHouse,Meerut.

Thomas, Medicinal Chemistry: An Introduction, Wiley-Interscience,2nd edition,2008

Reference Books:

1. B.K.Sharma–Instrumental methods of chemical Analysis, Goel publishing House, Meerut
2. G.P.A. Turner –Principles of Paint Chemistry and Introduction to paint Technology Oxford & IBH Publishing & Co Paint Film Defects.
3. Wilson and Giswald's Textbook of Organic Medicinal and Pharmaceutical Chemistry by John Block and John M Beale (Eds), Lippincott Williams &Wilkins, 11th edition,2003.
4. Richard B.Silverman, The Organic Chemistry of Drug Design and Drug Action, Academicpress,2nd edition,2004

Web Resources

1. https://pubs.acs.org
2. https://www.iiserbpr.ac.in

Course Outcomes:

CO1: Identify industrial problems related to chemistry and find solutions for them

CO2: Be able to work in quality control or analytical laboratories.

CO3: Organize and manage effectively in science laboratories

CO4: Function as industrial chemist, assistant research scientist in industrial, research and university

CO5: Labs, maintain general safety rules and codes of behavior in chemical laboratories.

Mapping of Cos with Pos & PSOs:

CO/PO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-III / Elective Course- II	INDUSTRIAL CHEMISTRY	Course Code: PQE2
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks -75	Total Marks: 100

Cognitive Level	***K1- Acquire / Remember*** ***K2- Understanding*** ***K3- Apply K4-*** ***Analyze K5-*** ***Evaluate*** ***K6- Create***	
Course Objectives	• To understand and develop efficacy in planning, designing, production processing and Marketing • To study water testing treatment and petroleum refining. • To acquire in depth knowledge of basic and applied area of industrychemistry. • To know the industrial production of soaps, detergents andperfumes. • To learn the process of photography.	
UNIT	***CONTENT***	***HOURS***
Unit -I	**Basic Ideas about Unit Operation** Basic ideas about unit operation – Flow charts – Chemical conversion – Batch versu continuous processing – chemical process selection – design – chemical process control chemical process economics– market evaluation – plant location –management i productivity and creativity. Research & development and its role inchemical industries.	**(18 Hrs)**

Unit - II	**Petroleum and Detergents** Water conditioning for chemical factories – reuse – methods of conditioning demineralization – precipitation – desalting – industrial and sewage waste watertreatment. Vegetable oils – Refining of edible oils – solvent extraction – processing of animal fat – hydrogenation– inter esterification – manufacture of soap from oils. Petroleum: Origin, refining, cracking, reforming, knocking and octane number, LPG, synthetic gas, synthetic petrol.Detergents – raw materials – manufacture – Biodegradability of surfactants–methods.	**(18 Hrs)**
Unit- III	**Pulp, Paper and Plastics** Pulp and paper industries – Sulphite, Sulphate, Soda, Ground wood pulp for paper manupaper – speciality paper – paper stock – structural boards. Plastics – manufacture – resin – manufacturing processes – condensation polymerization manufacture of laminates and other derivatives – Hexamethylenetetramine plastics – vin Wood conversions – Hydrolytic wood – Phenolic treatment wood – chip wood and their manufacture & advantages – fireretardingwood.	**(18 Hrs)**
Unit - IV	**PERFUMES** Introduction – Definition - uses and economics -.production of natural and synthetic perfumes – Flower perfumes – Fruit flavours – artificial flavours.	**(18 Hrs)**
Unit - V	**SUGAR CHEMISTRY AND PHOTOGRAPHY** Sugar manufacture – starch and related products – miscellaneous starch. Manufacture of industrial alcohol – Butanol - acetone – vinegar – acetic acid – citric acid – lactic acid by fermentation. Industrial and military explosives – manufacture pyro techniques – manufacture of safety matches. Colour photography – theory – material sand process–special applications of photography.	***(18 Hrs)***

Text Book

1. Charkarbharthy B N, Industrial Chemistry, Oxford and IBH Publishing .Co.1st Edition.NewDelhi.
2. Daniels etal., Experimental Physical chemistry, 7th Ed, New York, McGrawHill,1970.
3. Sharma B K**,** Industrial Chemistry, geol Publishing House,Meerut.

Reference Book

1. Norris Shreve.R. andJoseph.A.Brink Jr -Chemical process Industries –. McGraw Hill,International BookCompany,London.
2. Brain A.C.S. Remhold-Production andproperties of Industrial Chemicals– NewYork.
3. Burgh, AFermentation industries –Interscience,NewYork.
4. Gilbert.J.Hand book of Technology and Engineering –, Van NostrandReinhold,London.
5. Guthrie. V -Petroleum products Handbook.McGrawHill,Tokyo.

e- Resources

1.https://www.essentialchemicalindustry.org

2.https://www.tandfonline.com

Course Outcomes

CO1:Identify and understand the unit operations involved in a process

CO2:Design common heat exchangers like double pipe and shell & tube to determinerelevant design parameters

CO3:Understand the commercial processes used for the refining and processing of natural gas and crude petroleum

CO4:Solve materials and energy balances alone

CO5:Simultaneously on chemical processsystem

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	W	S
CO2	S	S	S	S	S	M	M	S	M	S
CO3	S	S	S	S	M	S	S	M	S	S
CO4	S	S	S	M	M	S	S	M	S	S
CO5	S	S	S	M	M	S	S	M	S	S

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SKILL DEVELOPMENT

Semester- IV /Elective course-IV	**ANALYTICAL CHEMISTRY**	**Course Code: PQE5**
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks - 25	External Marks- 40	Total Marks: 100

Cognitive Level	K1- Acquire / Remember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	To study thermo analytical techniques for chemical analysis. To understand electro analytical techniques. To learn the nature of errors and their types. To gain sound knowledge on methods of crystal growth. To learn diffraction studies and its applications.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**THERMO ANALYTICAL METHODS** Thermogravimetry : Principle, factors affecting thermogram, instrumentation and thermal decomposition ofCaC2O4H2O andCuSO4.5H2O Differential Techniques : Instrumentation, experimental, instrumental factors of DTA and D Thermal studies of CuSO4.5H2O by DTA and determination of purity of pharmaceutical an transition studies by DSC-evaluation of thermodynamic parameters.	**(18 Hrs)**

Unit - II	**ELECTROANALYTICAL METHODS** Electro gravimetry : Principle, instrumentation, deposition and separation Electrolysis at constant current and estimation of copper. Coulometry : Principle, controlled potential coulometry and separation of nickel and cobalt, coulometric titration, instrumentation – estimation of Sb(III) Potentiometry : Principle, potentiometric titration, equivalence point potential for (i)Fe^{2}+- Ce ^{4}+ system (ii) Fe^{2}+ - $MnO4^{-}$/H+ system. Colorimetry Beer- lambert's law and spectrophotometric method of estimation, principle and methods of visual colorimetry.Estimation of iron and nickel by visual colorimetry.	**(18 Hrs)**
Unit- III	**DATA ANALYSIS** **ERRORS** : Various types of errors – precision and accuracy – significant figures – various statistical test on accuracy of results, positive & negative deviation from accurate results – the binomial distribution, the Gaussian distribution – the normal distribution of random errors, mean value, variation and standard deviation, reliability interval, deviation from the Gaussian law of error distribution. Student's t-distribution & t-tests, comparison of the mean with the expected value, comparison of the results of two different methods, comparison of precision of two methods by F-tests, gross errors and elimination of outlying results.Graphical methods Linear regression, regression line, standard deviation, correlationco-efficient.	**(18 Hrs)**

Unit - IV	**CRYSTALLOGRAPHY** Single crystal growth – low and high temperature, solution growth technique – gel and sol- gel methods. Melt growth – Bridgeman – stockberger method, Czochralski methods. Flux technique, physical and chemical vapour transport methods. Characterization – TGA/DTA/DSC methods, SEM/TEM analysis. Determination of hardness.Applicationsofsingle crystals.	**(18 Hrs)**
Unit - V	**DIFFRACTIONSTUDIES** X-ray Diffraction -Powder and single crystal method, advantages over neutron diffraction methods, applications of x-ray diffraction method. Neutron diffraction, advantages over Electron diffraction, limitations. Electron diffraction studies -limitations and applications.	**(18 Hrs)**

Text Books:

1.A.K.Srivastava,P.C.JainChemicalAnalysis:AnInstrumentalApproach forB.Sc.Hons &M.Sc classes, S.ChandCompanyLtd.

2.D.C.Harris,QuantitativeChemicalAnalysis;4t^{h}Ed.,W.H.Freeman Publications, NewYork, 1995.

3.A.K.Srivastava, P.CJain.Instrumental Methodsof ChemicalAnalysis

4.S.Gopalan.AnalyticalChemistry

5..Clegg,W, Crystal structure determination, Oxford University press , New York.

References Books:

1.D.B.HibbertandJ.J.Gooding,DataAnalysisforChemistry;Oxford University Press, UK,2006 2.J.Topping,ErrorsofObservationandTheirTreatment;4th Ed.,ChapmanHall, London,1984.

3.MahinderSingh.Text Book of Analytical Chemistry InstrumentalTechniques

e- Resources

1.https://edu.rsc.org

Course Outcome:

After successfully completing this course, students will be able to:

CO1: Explain the theoretical aspects of key analytical techniques and instruments

CO2: Strategically plan analytical campaigns to apply to different types of samples and research objectives, including selection of the most appropriate technique/instrumentation for the students' research project.

CO3: Undertake the correct sample preparation and characterization prior to analysis by the chosen techniques or instruments.

CO4: Design an analytical work-flow to acquire data

CO5: Process data from the chosen instruments and demonstrate understanding of the limitations and quality of the data. Justify the approach taken to data processing.

Mapping of Cos with Pos & PSOs:

CO/PO	PO					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlated

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Semester-IV / Elective Course-V	RECENT TRENDS IN CHEMISTRY	Course Code: PQM
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1- Acquire / emember K2- Understanding K3- Apply K4- Analyze K5- Evaluate K6- Create	
Course Objectives	• Gain knowledge in Nano Chemistry. • Acquire the ideas about material science. • Learn about Supra molecular chemistry in solutions. • Understand basic principles & reactions in Green Chemistry. • Study basic knowledge and resources in chem. informatics.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**NANO CHEMISTRY** Nano chemistry & fundamentals–Introduction–electronic structure– transport properties–mechanical properties– physical properties–applications– Nano tubes of other materials. Nano Science: Self assembled monolayers–Introduction–mono layers on gold–growthprocess–phase transitions – pattering mono layers– mixed mono layer – SAME and applications.	**(18 Hrs)**
Unit - II	**MATERIAL SCIENCE** Crystal-crystal lattice-crystal defects- fullerene super conductors-High temperature materials-biomaterials-thermo electronic materials- nano phase materials- smart material–NLO materials-conducting polymers.	**(18 Hrs)**

Unit- III	**SUPRA MOLECULAR CHEMISTRY** Supra Molecular Chemistry – Concepts and Languages of supramolecular Chemistry – Supramolecular Reactivity and Catalysis. Catalysis by Reactive Macrocyclic Cation Receptor Molecules. Catalysis by Reactive Anion Receptor Molecules. Catalysis with Cyclophanes. Type Receptors. Supramolecular Metallocatalysis. Cocatalysis: Catalysis of Synthetic reactions. Biomolecular and Abiotic catalysis. Supramolecular Chemistry in solution Cyclodextrin, Micelles, Dendrimmers, Gelators. Classification and typical reactions-Applications**.**	**(18 Hrs)**
Unit - IV	**GREEN CHEMISTRY** Green Chemistry– PhotoChemical Principles– Photooxidation–photodegradation–Removal of hazardous chemicals from water –cleaner production concept–Implementation -Government rule.	**(18 Hrs)**
Unit - V	**CHEM- INFORMATICS** Chem-Informatics: Introduction – Evaluation – History and uses – molecular modeling using computer Basic idea - chemical information data base design and their management – data base concepts –structural languages chemical database design Chemical information sources–chemical information researches formula searching.	**(18 Hrs)**

Text Books:

1. T. Pradeep " Nano the essentials – understanding Nano Science and NanoTechnology" Tata McGraw - hill publishing Ltd., New Delhi, 2007.
2. M.M. Srivatsava, Rashmi Sangi "Chemistry for Green Environment, Narosa publishing House,New Delhi 2005.

References Books :

1. C. N. R. Rao, A. Muller and A. K. Cheetham (Eds), The Chemistry of Nanomaterialand 2; Wiley-VCH;Germany,Weinheim,2004.
2. C. P. Poole, Jr: and F. J. Owens, Introduction to Nanotechnology;WileyInterscienceNewJersey,2003.

3. P. T. Anastas and J. C. Warner, Green chemistry Theory and Practice;Oxford University Press,New York, 2005.
4. J .W.Steed&J.L.Atwood,SupramolecularChemistry,Wiley,2000.
5. Frank Jenson,IntroductiontoComputationalChemistry,Wiley,Newyork,1999.

e- Resources

1. https://www.understandingno.com
2. https://webs.iiitd.edu.in

Course outcomes :

After successfully completing this course, students will be able to:

CO1: Provide perspectives on future nanochemistry developments

CO2: Follow new developments in material application field.

CO3: Explain importance of materials in materials science and scientific filed

CO4: Have an appreciation of the significance and application of supramolecular chemistry, including in dynamic combinatorial chemistry, materials chemistry (e.g. soft materials, porous hybrid and other framework solids), biological systemsand the controlled construction of nanoscale entities]

CO5:A functional understanding of the field of green chemistry. Chemoinformatics is a rather new discipline in science. It has been described as theapplication of informatics methods to solve chemical problems

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	PO					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester- II/ Elective course-I	NON – COVENTIONAL ENERGY SOURCES	PQE1
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks - 75	Total Marks: 100

Cognitive Level	K-1Acquire / Remember K-2 Understand . K-3 Apply K-4 Evaluate K-5 Analyze K-6 Create	
Course Objectives	• To understand the various types of energy sources. • To learn about the solar energy • To introduce the importance of wind energy & fuel cells. • To acquire knowledge about bioenergy. • To know the different tidal power plants.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**ENERGY SOURCES** Introduction to energy - Different forms of energy - Primary & Secondary Energy sources - Various types of Conventional Energy Sources- Fossil fuel energy,Hydraulic energy & Nuclear energy - Various types of Non-Conventional Energy Sources - Wind energy,Tidal energy & Solar energy.	**(18 Hrs)**
Unit-II	**SOLAR ENERGY** Introduction - Solar Constant - Solar Radiation at the Earth's Surface - Solar Energy applications - Solar Cooker - Design principle , constructional details and limitations of Solar Cooker - Solar Water heater - Solar distillation - Solar Pumping - Electricity from Solar Energy - Street lighting system.	**(18 Hrs)**

Unit-III	**WIND ENERGY AND FUEL CELLS** Wind energy - Classification of wind mills - Horizontal Wind mills, Wind Mills – Advantages & Disadvantage of Windenergy. Fuel cells – Introduction - Working of Fuel Cell - Advantages of Fuel Cells	**(18 Hrs)**
Unit- IV	**BIO ENERGY** Introduction - Bio Gas and its Compositions - Process of Bio gas, generation – Wet Process, dry Process - Raw Materials available for Bio gas Fermentation - Constructional Details of Biogas Plant - Utilization and benefits of Biogas Technology - Economical, social environmental and health benefits of bio gas - Utilization - KVIC Bio gas Plant - Advantages of Bio Gas technology.	**(18 Hrs)**
Unit -V	**TIDAL POWER PLANTS** Introduction to Tidal Power Plants - Classification of tidal Power Plants - Working of Different Tidal Power Plants - Factors affecting the suitability of the site for tidal power plant - Advantages and disadvantages of Tidal Power Plants - Components of Tidal Power plants.	**(18 Hrs)**

Text book:

1. G.D Raj,Non – Conventional Energy Sources, Khanna Publisher, 1998.
2. G.S. Sawhney,Non – Conventional Energy Sources, PHI Learning,2005.
3 N.K. Bansal,Non – Conventional Energy Source, Vikas Publishing house.
4 B.H.Khan, Non Conventional Energy Sources, Mc Graw Hill Publications,3rd Edition

Reference book:

1. Roger H.Charlier, Charles W. " Ocean Energy- Tide and Tidal Power"ISBN:
2. Library of Congress Control Number:2008929624_c Springer-VerlagBrerlin Heidelberg 2009.

3. John F.Walker&N.Jenkins, "Wind Energy Technology", John Willey and Sons Chichester,U.K – 1997.
4. T H Taylor Alternate Energy Sources by.AdamHilger Ltd, Bristol

Web resources:

https://www.topfreebooks.org

Course outcomes:

On completion of the Course, Students should be able to

1. **To ensure the students understand the basic concept of energy.**
2. **Understand the solar devices such as solar cooker, solar water heater.**
3. **To get awareness about the wind energy and conversion to the generation of power.**
4. **An introduction of composition of biogas and generation of power.**
5. **To study about the principles of geothermal and tidal power plant**

Mapping of Course outcomes with Programme outcomes / Programmes Specific outcomes:

CO/PO	PO					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

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