A.D.M. COLLEGE FOR WOMEN

(AUTONOMOUS)

Nationally Accredited with "A" Grade by NAAC - 3rd Cycle

(Affiliated to Bharathidasan University, Thiruchirappalli)

No.1, College Road, Velippalayam,

Nagapattinam – 611 001, Tamil Nadu, India

PG & RESEARCH DEPARTMENT OF CHEMISTRY

(For the candidates admitted from the academic year 2021-2023)

M.Sc., CHEMISTRY

SYLLABUS

2021-2023

A.D.M COLLEGE FOR WOMEN (AUTONOMOUS),

Nagapattinam

UG Programme - M.Sc Chemistry

(For the candidates admitted from 2021 – 2022 onwards)

Bloom's Taxonomy Based Assessment Pattern

Knowledge Level

K1 – Recalling	**K2** – Understanding	**K3** – Applying	**K4** – Analyzing	**K5** – Evaluating	**K6** – Creating

Part I, II and III

Theory (External + Internal = 75 + 25 = 100 marks)

External/Internal					
Knowledge Level	**Section**	**Marks**	**Hrs**	**Total**	**Passing Mark**
K1-K3	A (Answer all)	10 ×2 = 20	3	75	40
K3-K6	B (Either or pattern)	5 × 5 = 25			
K3-K6	C (Answer 3 out of 5)	3 × 10 = 30			

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

(For the candidates admitted from 2021 – 2022)

M.Sc. CHEMISTRY

Programme Educational Objectives (PEO):

PEO 1:	To develop critical analysis and problem solving skills required to interpret the data into structures and mechanisms.
PEO 2:	Gain knowledge of experimental techniques and instrumentation enables to work independently in research in different areas at a global level.
PEO 3:	Actively participate in organizing and presenting acquired knowledge coherently both orally and in written discourse relating to chemistry
PEO 4:	To prepare the students to successfully compete for current employment opportunities and emerge as entrepreneurs.
PEO 5:	Work alongside of physicists, engineers, environmentalists, biomedical scientists, pharmacists, doctors and other professionals to help solving scientific problems.

Programme Outcomes (POs) PG

On completion of the course the learner will be able

PO 1:	Acquire knowledge in major areas of chemistry.
PO 2:	Perform chemical analysis to determine composition of various chemical compounds.
PO 3:	Use knowledge of chemistry for solving problems in environmental, food processing, pharmaceutical, biochemical, agriculture, fuels and chemicals, textile processing, mining and many other industries.
PO 4:	Use modern tools and techniques in literature survey, designing synthesis and characterizing crystals.
PO 5:	Manage information, develop technical reports and make presentations.

Programme Specific Outcomes (PSO) M.Sc.,

On completion of the course the learner will be able

PSO 1:	Introduce advance techniques and ideas required in developing area of chemistry.
PSO 2:	Provide theoretical background and develop practical skills for analyzing materials using modern analytical methods and instruments.
PSO 3:	Inculcate a problem solving approach provide coordinating the different branches of chemistry.
PSO 4:	Effectively communicate themes relating to chemistry
PSO 5:	Proficient in their specialized area of chemistry and acquire the basic tools needed to carry out.

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PG AND RESEARCH DEPARTMENT OF CHEMISTRY

COURSE STRUCTURE OF PG PROGRAMME – M.Sc CHEMISTRY

Papers	**No. of Courses**	**Hours**	**Credit**
Core papers & practicals	14	84	61
Elective papers	5	30	25
Project	1	6	4
Total	**20**	**120**	**90**

Marks / Papers	**C.I.A**	**S.E**
Theory Paper	25	75
Practical Paper	40	60

Passing Minimum

A candidate shall be declared to have passed in each course if she secures not less than

40% marks in the End Semester Examination and 40% marks in the Continuous Internal Assessment and not less than **50% in the aggregate**, taking Continuous Internal Assessment and End SemesterExamination marks together.

A.D.M. COLLEGE FOR WOMEN (AUTONOMOUS), NAGAPATTINAM

PG & RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY

Course Structure under CBCS

(For the candidates admitted from the academic year 2021-2022 onwards)

Sem.	Part	Course Code	Course	Ins. Hrs	Credit	Exam Hours	Marks		Total Marks
							CIA	SE	
I	III	PGQA	CC I -Organic Chemistry I	6	6	3	25	75	100
	III	PGQB	CC II-Inorganic Chemistry I	6	5	3	25	75	100
	III	PGQC	CC III-Physical Chemistry I	6	5	3	25	75	100
	III	PGQDY	CP I-Organic Chemistry practical I	6	3	6	40	60	100
	III	PGQEY	CP II-Inorganic Chemistry practical I	6	3	6	40	60	100
	Total			**30**	**22**				**500**
II	III	PGQF	CC IV -Inorganic Chemistry II	6	5	3	25	75	100
	III	PGQG	CC V-Physical methods in chemistry –I	6	6	3	25	75	100
	III	PGQHY	CP III-Organic Chemistry practical II	6	3	6	40	60	100
	III	PGQIY	CP IV-Inorganic Chemistry practical II	6	3	6	40	60	100
	III	PGQE1	EC I- Non-Conventional Energy sources/ Computer applications and C programming	6	5	3	25	75	100
	Total			**30**	**22**				**500**

Sem.	Part	Course Code	Course	Ins. Hrs	Credit	Exam Hours	Marks		Total Marks
							CIA	SE	
III	III	PGQJ	CC VI -Organic Chemistry-II	6	5	3	25	75	100
	III	PGQK	CC VII -Physical Chemistry II	6	6	3	25	75	100
	III	PGQLY	CP V -Physical Chemistry Practical–I	6	3	6	40	60	100
	III	PGQE2	EC II- Industrial Chemistry/ Bioinorganic Chemistry	6	5	3	25	75	100
	III	PGQE3	EC III- Green Chemistry /Molecular modeling and drug design	6	5	3	25	75	100
	Total			**30**	**24**				**500**
IV	III	PGQM	CC VIII- Physical methods in Chemistry-II	6	5	3	25	75	100
	III	PGQNY	CP VI-Physical Chemistry Practical –II	6	3	6	40	60	100
	III	PGQE4	EC IV- Applied Chemistry/ Forensic Science	6	5	3	25	75	100
	III	PGQE5	EC V- Recent Trends in Chemistry /Petrol and Petrochemical products	6	5	3	25	75	100
	III	PGQP	Project	6	4	3	25	75	100
	Total			**30**	**22**				**500**
Grand Total				**120**	**90**				**2000**

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

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Understand the basic concepts of aromaticity. • Learn the oxidation and reducing reagents for organic synthesis. • Gain in depth knowledge in stereo chemistry of organic compounds. • Illustrate the effect of light in organic reactions. • Study the concerted pericyclic reactions.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**AROMATICITY** Aromatic character: Five, six, seven-, and eight membered rings – other systems with aromatics extets–Huckel's theory of aromaticity, concept of homo aromaticity and antiaromaticity. Electron occupancy in MO's and aromaticity – NMR concept of aromaticity and antiaromaticity, systems with 2,4,8 and 10 electrons, systems of more than 10electrons (annulenes), Mobius aromaticity. Bonding properties of systems with (4n+2) π-electrons and 4nπ- electrons, alternant and non- alternant hydrocarbons (azulene type)– aromaticity in hetero aromatic molecules, sydnones and fullerenes.	**(18 Hrs)**
Unit - II	**REAGENTS IN ORGANIC SYNTHESIS** Oxidation :Baeyer-Villiger, Jacobsen epoxidation, Shiepoxidation, Jones reagent, PCC, PDC ,IBX, DMP ,CAN, TPAP, NOCl, Mn (OAc)3, Cu(OAC)2 ,Bi2O3, Swern oxidation, Sommelet reaction, Elbsreaction, Oxidative coupling of phenols, Prevost reaction and Woodward modification. Reduction palladium /platinum /rhodium /nickel based heterogeneous catalysts for hydrogenation, Wilkinson's catalyst, Noyori asymmetric hydrogenation–reductions using Li/Na /Cainliquid ammonia. Hydride transfer reagents from group III and groupIV inreductions. (i)triacetoxyborohydride, L-selectride, K-selectride, Luche reduction, Red-Al,NaBH4 and NaCNBH3 ,trialkyl silane sandtri alkyl stannane (ii)stereo/enantios electivity reductions (Chiral Boranes, Corey- akshi-S hibata).	**(18 Hrs)**

Unit- III	**STEREOCHEMISTRY AND CONFORMATIONAL ANALYSIS** Stereoisomerism– symmetry– enantiomers and diastereomers –*R* and *S* nomenclature optical activity and chirality– types of molecules exhibiting optical activity–absolute configuration–chirality in molecules with non- Carbon stereocenters (N,SandP) – molecules with more than one chiral centre– atropisomerism. Molecular chirality – allenes, spiranes ,biphenyls, helicenes and cyclophanes–methods of determining configuration – *E* and *Z* nomenclature–determination of configuration of geometrical isomers – stereochemistry of addition and elimination reactions – stereospecific and stereoselective synthesis [elementary examples]. Basic concepts of conformations of cyclopentane ,cyclohexane, cyclo hexene and fused (decalin) and bridged (norbornane type) ring systems–anomeric effect in cyclic compounds.	**(18 Hrs)**
Unit - IV	**ORGANIC PHOTO CHEMISTRY** Organic photochemistry –fundamental concepts– energy transfer characteristics of photoreactions– photoreduction and photooxidation, photosensitization. Photoreactions of ketones and enones– NorrishTypeI and II reactions– Paterno- Büchi reaction– photo- Fries rearrangement – photochemistry of alkenes, dienes and aromatic compounds– di-π-methane rearrangement. Reactions of unactivated centres – photochemistry of α, β-unsaturated carbonylcompounds–photolytic cyclo additions and photolytic rearrangements–photoadditions–Bartonreaction.	**(18 Hrs)**
Unit - V	**PERICYCLIC REACTIONS** Concerted reactions– orbital symmetry and concerted symmetry – Woodward and Hoffmann rules–selection rules for electrocyclic reactions– frontier molecular orbital approach–correlation diagram– examples. Selection rules for cyclo addition reactions– frontier molecular orbital approach-correlation diagram–examples– chelotropic and ene reactions. Sigmatropic rearrangements– 1,3, 1,5 and 1,7-hydrogen shifts – examples –Cope and Claisen rearrangements – 1,3-dipolar cyclo addition reactions: types of dipoles, selectivity, scope and applications.	**(18 Hrs)**
Unit VI Self Study	Molecular dissymmetry, specific and molar rotation, polarimetry, E,Z notation, optical isomerism of lactic and tartaric acids.	

Text Book:

1. J.March and M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure; 7thEd., Wiley,NewYork,2013
2. R.K. Bansal, Organic Reaction Mechanisms; 11thEd., Tata McGraw Hill, Noida,2006.

Reference Book:

1. I.L.Finar, OrganicChemistry; Vol.II, 7th Ed.,Pearson education Ltd, NewDelhi, 2009.
2. F.A.Careyand R.J.Sundberg, Advanced Organic Chemistry Parts A and B, 5th Ed., Springer, Germany, 2007.
3. T.H.E. Lowry and K.S.Richardson, Mechanism and Theory in Organic Chemistry; Addison-Wesley,USA 1998.
4. E.L.Eliel, and S.H.Wilen, Stereochemistry of Organic Compounds; John Wiley, NewYork, 1994.
5. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry; 1st Ed. Oxford University Press,UK, 2000.

Web - Resources:

1. https:// www.quora .com
2. https://www.rsc.org
3. https://www.e-booksdirectory.com

Course Outcomes:

On completion of the course the learner will be able

CO 1: Gain the knowledge in the field of stereochemistry.
CO 2: To introduce synthetic methodology of preparation of compounds.
CO 3: Discuss the various methods of determination of Reaction mechanism.
CO 4: Explain the criteria for Chirality and discuss axial, Planar and helical chirality
CO 5: Discuss the photochemistry of pi-pi* transitions

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	M	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	M	M	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- I / Core Course-II	INORGANIC CHEMISTRY I	Course Code: PGQB
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks - 75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Understand the basic concepts of main group elements. • Detection of complex formation and factors affecting stability. • Learn the theories and mechanism of reactions of metal complexes. • Describe bonding in coordination compounds. • Study the concepts of photochemistry and its applications.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**MAIN GROUP CHEMISTRY** Chemistry of boron–borane, higher boranes, carboranes, borazines and boron nitrides–chemistry of silicon–silanes, higher silanes, multiple bonded systems, disilanes, silicon nitrides. P-N compounds, cyclo phosphazanes and cyclo phosphazenes – S-N compounds – S_2N_2, S_4N_4, $(SN)_x$, polythiazyl S_xN_4 compounds – S-N cations and anions, S-P compounds –molecular sulphides such as P_4S_3, P_4S_7, P_4S_9 and P_4S_{10}–homo cyclic inorganic systems- oxo carbonanion. Ionic model – lattice energy – Born-Lande equation – Kapustinskii equation – high T_c super conductors – solid state reactions – tarnish reaction decomposition, solid-soild reaction and photo graphic process– factors affecting reaction rate.	**(18 Hrs)**
Unit - II	**PRINCIPLES OF COORDINATION CHEMISTRY** Studies of coordination compounds in solution– detection of complex formation in solution– stability constants–stepwise and overall formation constants. Simple methods (potentiometric, pH metric and photometric methods) of determining the formation constants. Factors affecting stability –statistical and chelate effects– forced configurations.	**(18 Hrs)**
Unit- III	**THEORIES OF METAL- LIGAND BOND** Crystal field theory – splitting of d-orbitals under various geometries – factors affecting splitting– CFSE and evidences for CFSE (structural and thermodynamic effects). Spectrochemical series – Jahn-Teller distortion – spectral and magnetic properties of complexes–site preferences. Limitations of CFT– ligand field theory– MO theory–sigma- and pi-bonding in complexes– Nephelauxetic effect– the angular overlap model.	**(18 Hrs)**
Unit - IV	**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	**(18 Hrs)**

	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 – interconversion of stereoisomers – reactions of coordinated ligands – template effect and its applications for the synthesis of macro cyclic ligands – unique properties.	
Unit - V	**INORGANIC PHOTOCHEMISTRY** Electronic transitions in metal complexes, metal-centered and charge-transfer transitions–various photo physical and photo chemical processes of coordination compounds. Uni molecular charge-transfer photo chemistry of cobalt(III) complexes –mechanism of CTTM, photo reduction–ligand- field photochemistry of chromium(III) complexes–Adamson's rules, photo active excited states, V-Cmodel– photo physics and photo chemistry of ruthenium – poly pyridine complexes, emission and redox properties. Photochemistry of organo metallic compounds– metal carbonyl compounds –compounds with metal-metal bonding–Reinecke's salt chemical action meter.	**(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. M. C. Day, J. Selbin and H. H. Sisler, Theoretical Inorganic Chemistry; LiteraryLicensing (LLC),Montana, 2012.
2. F.A.Cotton and G. Wilkinson, C.A. Murillo and M. Bochmann, Advanced Inorganic Chemistry; 6th Ed., A Wiley - Interscience Publications, John Wiley andSons,USA,1999

References:

1. .R. K. Sharma, Inorganic Reactions Mechanism; Discovery Publishing House, New Delhi, 2007.
2. S. F. A. Kettle, Physical Inorganic Chemistry – A Coordination Chemistry Approach, Spectrum; Academic Publishers, Oxford University Press, NewYork 1996.
3. A.W.Adamson and P.D.Fleischauer, Concepts of Inorganic Photo chemistry; R.E.Krieger Pubs, Florida, 1984.
4. J.Ferraudi, Elements of Inorganic Photo chemistry; Wiley, New York, 1988.
5. F. Basolo and R. G. Pearson, Mechanism of Inorganic Reactions; 2nd Ed., JohnWiley,NewYork, 1967.

Web - Resources:

1. www.sciencedirect.com
2. https://sites.google.com
3. www.freebookcentre.net

Course Outcomes:

On completion of the course the learner will be able

CO 1: Gain idea about the recent advances in Inorganic chemistry

CO 2: Identify the synthesis, structure and bonding of carbon-pi-donor complexes

CO 3: Calculate magnetic moment & crystal field Stabilization energy of metal complexes.

CO 4: Explain about different type of electron transfer Reaction (one electron transfer reaction & direct electron transfer reaction) and factors affecting them.

CO 5: Acquire knowledge about the basic principles of photo inorganic chemistry

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	M	S	S	M	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- I / Core Course-III	PHYSICAL CHEMISTRY I	Course Code: PGQC
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks - 75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Understand the concepts of group theory and quantum chemistry. • Learn the chemical kinetics and statistical thermodynamics. • Study the theories of kinetics, photo chemistry and radiation chemistry. • Describe the importance of statistical mechanics. • Acquire knowledge about quantum statistics.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**CONCEPTS OF GROUP THEORY** Symmetry elements and operations – point groups – assignment of point groups to molecules–group postulates and types of groups – group multiplication tables, sub groups, similarity transformations – conjugate elements and classes. Matrix representation of symmetry operations and point groups – reducible and irreducible representations–properties of irreducible representation. The great orthogonality theorem–construction of character table – direct product–projection operators–symmetry of hybrid orbitals.	**(18 Hrs)**
Unit - II	**QUANTUM CHEMISTRY-I** Inadequacy of classical mechanics–black body radiation–Planck's quantum concept–photo electric effect–Bohr's theory of hydrogen atom– hydrogen spectra–wave-particle dualism – uncertainty principle – decline of old quantum theory. Schrödinger equation–postulates of quantum mechanics –operator algebra linear operator, Hermitian operators, eigen functios and eigen values, angular momentum operator–commutation relations and related theorems–orthogonality and normalization. Applications of wave mechanics to simple systems – particle in a box, one and three dimensional, particle with finite potential barrier–the quantum mechanical tunneling	**(18 Hrs)**
Unit- III	**CHEMICAL KINETICS-I** Theories of reaction rate – absolute reaction rate theory (ARRT) – transmission coefficient, reaction coordinate–potential energy surfaces – kinetic isotope effect–Hinshelwood theory–Kassel, Rice	**(18 Hrs)**

	and Ramsperger theory (KRRT)–Slater's treatment. Principle of microscopic reversibility–steady-state approximation–chain reactions: thermal and photochemical reactions between hydrogen and halogens–explosions and hydrogen-oxygen reactions.	
Unit - IV	**STATISTICAL THERMODYNAMICS** Thermodynamic probability –probability theorems–relation between entropy and probability (Boltzmann Planck equation), ensembles, phase space, Ergodic hypothesis, microstates and macro states, Maxwell-Boltzmann distribution law partition functions–translational, rotational, vibrational and electronic partition functions. Relationship between partition functions and thermodynamic properties–calculation of equilibrium constants from partition functions – heat capacities of monatomic crystals–Einstein theory and Debyetheory. Quantum statistics – Bose-Einstein (B.E.) and Fermi-Dirac (F.D.) distribution equations – comparison of B.E. and F.D. statistics with Boltzmann statistics–applications of quantum statistics to liquid helium , electrons in metals and Planck's radiation law–concept of negative Kelvin temperature.	**(18 Hrs)**
Unit - V	**FAST REACTION TECHNIQUES, PHOTO CHEMISTRY AND RADIATION CHEMISTRY** Introduction–flow methods (continuous and stopped flow methods) – relaxation methods (T and P jump methods) – pulse techniques (pulse radiolysis, flash photolysis)–shocktube method–molecular beam method–life time method. Photo physical processes of electronically excited molecules –Jablonski diagram Stern-Volmer equation and its applications–experimental techniques in photochemistry–chemical actinometers –lasers and their applications. Differences between radiation chemistry and photo chemistry – sources of high energy radiation and interaction with matter–radiolysis of water, solvated electrons – definition of G value, Curie, linear energy transfer (LET) and Rad–scavenging techniques–use of dosimetry and dosimeters in radiation chemistry–applications of radiation chemistry.	**(18 Hrs)**
Unit VI **Self Study**	Units of rate constants for different orders of the reactions- Comparison between order and molecularity of a chemical reaction.	

Text Book:

1. Horia Metiu, Physical Chemistry, Thermodynamics; Taylor and Francis, Singa 2006.

2. K.K.Rohatgi-Mukherjee, Fundamentals of Photo chemistry;3rd Ed., New Age International Pvt.Ltd., New Delhi,2014.

3. J. W. T. Spinks and R. J. Woods, Introduction to Radiation Chemistry; 3rdEd., John Wiley and Sons, New York, 1990. Wiley and Sons, New York, 1990.

References:

1. F.A.Cotton, Chemical Applications of Group Theory; 3rdEd., John Wiley and Sons, Singapore,2003.

2. A.K.Chandra, Introductory Quantum Chemistry; 4thEd., Tata Mc GrawHill, Noida, 1994.

3. D.A.Mcquarrie, Quantum Chemistry; University Science Books, Sausalito, 2008.

4. I.N.Levine, Quantum Chemistry; 5thEd., Prentice Hall, New Jersey, 2000.

5. R. K. Prasad, Quantum Chemistry; 4th Ed., New Age International Publishers, New Delhi, 2014.

Web- Resources:

1. http://libguide.reading.ac.uk
2. http://library.iiti.ac.in

Course Outcomes:

On completion of the course the learner will be able

CO 1: Identify the point groups of molecules and apply the concept of group theory to predict the spectroscopic properties.

CO 2: Explain the concept of black body radiation, operators, commutation of Operators, eigen function, eigen value and well behaved function.

CO 3:Learn the concept of entropy, 3rd law of thermodynamics & evaluation of absolute entropy from heat capacity data

CO 4: Give the concept of distribution and probability and derive Boltzmann distribution law.

CO 5: Describe types of photo chemical reactions and Photo Sensitization reaction.

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	M	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- I / Core Practical-I	ORGANIC CHEMISTRY PRACTICAL I	Course Code: PGQDY
Instruction Hours: 6	Credits: 3	Exam Hours: 6
Internal Marks -40	External Marks-60	Total Marks: 100

Course Objectives	• To perform the qualitative analysis of a given organic mixture. • To carry out the preparation of organic compounds.	
	CONTENT	**HOURS**
	1. Qualitative analysis of an organic mixture containing two components Mixtures containing two components are to be separated (pilot separation) and purified (bulk separation) – physical constants are to be reported (analysis) **2. Preparation of organic compounds (single stage)** 1. Methyl-m-nitro benzoate from ethyl benzoate (nitration) 2. Glucose penta acetate from glucose (acetylation) 3. Resacetophenone from resorcinol (acetylation) 4. Benzo phenone oxime from benzophenone (addition) 5. o-Chlorobenzoic acid from anthranilic acid (Sand mayer reaction) 6. p-Benzoquinone from hydroquinone (oxidation) 7. Phenylazo-2-naphthol from aniline (diazotization)	**6 Hours per Week**

Text Book:

1. J. Mohan,Organic Analytical Chemistry: Theory and Practice; Narosa,2003.
2. V.K.Ahluwalia P.Bhagat, and R.Agarwal, Laboratory Techniques in Organic Chemistry; I.K. International, 2005.

References:

1. N.S. Gnanaprakasam and G. Ramamurthy, Organic Chemistry Lab Manual; S.V.Printers, 987.

2. A.I.Vogel, A.R.Tatchell, B.S.Furniss, A.J.Hannaford and P.W.G.Smith, Vogel's Text book of Practical Organic Chemistry; 5thEd., Prentice Hall, 1989.

Web - Resources:

1. https://organicchemistry data

Course Outcomes:
On completion of the course the learner will be able

CO 1: Gain knowledge on the skills of doing separation, preparation of chemical compounds.
CO 2: Learn about the methods of qualitative analysis of organic 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	S	S	S	S	S	S	S	S	S
CO2	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 Practical-II	INORGANIC CHEMISTRY PRACTICAL I	Course Code: PGQEY
Instruction Hours: 6	Credits: 3	Exam Hours: 6
Internal Marks -40	External Marks-60	Total Marks: 100

Course Objectives	• Perform the semi micro qualitative analysis. • Estimate the metal ions using colorimeter.	
	CONTENT	**HOURS**
	1. Semi-micro qualitative analysis of a mixture containing two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Ca, Mg, NH_4) and two less common cations (W, Tl, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li). **2. Estimation** of copper, ferric, nickel, chromium and manganese ions using photo electric colorimeter	**6 Hours per Week**

Text Book:

1. V. V. Ramanujam, Inorganic Semi micro Qualitative Analysis; 3rd Ed., National Pubs, London, 1988.
2. G.Svehla, Text Book of Macro and Semi micro Qualitative Inorganic Analysis; 5th Ed., Longman group Ltd, London, 1987.

Reference Book:

1. A.I.Vogel, Text Book of Quantitative Inorganic Analysis; 6th Ed., Longman, New Delhi, 2000

Web - Resources:

1. http://edu.rsc.org

Course Outcomes:

On completion of the course the learner will be able to

CO 1: Understand advanced method of estimation of metal ions through complexation

CO 2: Acquire knowledge about colorimetric analysis.

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	M	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester-II / Core Course- IV	INORGANIC CHEMISTRY-II	Course Code: PGQF
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Understand the role of metal ions in biological process. • Learn the basic concepts of chemotherapy. • Know the principle of catalysis and reaction mechanisms of organometallics. • Illustrate the structure and bonding in organometallics. • Acquire knowledge in the field of medicinal bioinorganic chemistry.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**GENERAL PRINCIPLES OF BIO INORGANIC CHEMISTRY** Occurrence and availability of inorganic elements in biological systems– bio mineralization–control and assembly of advanced materials in biology–nucleation and crystal growth–various bio minerals–calcium phosphate – calcium carbonate – amorphous silica, iron bio minerals – strontium and barium sulphate. Function and transport of alkali and alkaline earth metal ions: characterization of K^+,Na^+,Ca^{2+} and Mg^{2+}– complexes of alkali and alkaline earth metal ions with macrocycles –ion channels– ion pumps, catalysis and regulation of bio energetic processes by the alkaline earth metal ion s–$Mg^{2+}$and Ca^{2+}. Metals at the center of photosynthesis – primary processes in photosynthesis – photo systems I and II-light absorption (energy acquisition)– excitation transport (direct energy transfer)–charge separation and electron transport–manganese catalyzed oxidation of water to O2.	**(18 Hrs)**
Unit - II	**AMINES , PROTEINS AND ENZYMES** Cobalamines: reactions of the alkyl cobalamines – one electron reduction and oxidation–Co-Cbond cleavage – coenzyme B12– alkylation reactions of methyl cobalamin. Heme and non-heme proteins – haemoglobin and myoglobin – oxygen	**(18 Hrs)**

	transport and storage–electron transfer and oxygen activation – cytochromes, ferredoxins and rubredoxin–model systems, mononuclear non- heme iron enzymes. Copper containing proteins– classification and examples– electron transfer– oxygen transport-oxygenation–oxidases and reductases– cytochrome oxidase-Superoxide dismutase (Cu,Zn)–nickel containing enzyme: urease.	
Unit- III	**MEDICINAL BIOINORGANIC CHEMISTRY** Bioinorganic chemistry of quintessentially toxic metals–lead, cadmium, mercury, aluminium, chromium, copper and plutonium– detoxification by metal chelation– drugs that act by binding at them etalsites of metallo enzymes. Chemotherapy– chemotherapy with compounds of certain non-essential elements – platinum complexes in cancer therapy – cisplatin and its mode of action–cytotoxic compounds of other metals. Gold containing drugs as anti- rheumatic agents and their mode of action –lithium in psycho pharmacological drugs– radiopharmaceuticals– technetium**.**	**(18 Hrs)**
Unit - IV	**ORGANOMETALLICS:** The 18 electron rule –applications and limitations– isolobal concept and its usefulness–uses of typical organometallics such as metal alloys and organometallic hydrides in organic synthesis. Nitrosyl complexes – bridging and terminal nitrosyls, bent and linear nitrosyls –dinitrogen complexes–metallocene and arene complexes– metalcarbenes, carbenes, carboxylate anions. Classification based on captivity and polarity of M-C bond, organometallic compounds of lanthanides and actinides–fluxional organometallic compounds- organometallics in medicine,agriculture, horticulture and industry.	**(18 Hrs)**
Unit - V	**REACTIONS AND CATALYSIS BY ORGANOMETALLICS:** Organometallic reactions– ligand association and dissociation – oxidative addition and reductive elimination–insertion reactions. Reactions of coordinated ligands in organometallics–hydrogenation, hydroformylation, epoxidation, metathesis. Polymerization of olefins, olefin oxidation (Wacker process) and carbonylation of methanol.	**(18 Hrs)**
Unit VI **Self Study**	Antenna effect and funneling of electronic energy in supramolecular assemblie, Generation of 9 9 m Tc chelates	

Text Book:

1. J.E. Huheey, Inorganic Chemistry;4th Ed., Harper and Row Publishers, Singapore,2006.

2. K.F. Purcell and J.C. Kotz, Inorganic Chemistry; Thomson Learning, Boston, 1980.

3. S.J. Lippardand J.M. Berg, Principles of Bioinorganic Chemistry;Panima Publishing Company, NewDelhi, 1997.

Reference Books:

1. W. Kaim and B. Schewederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2ndEd., John Wiley and Sons, NewYork, USA, 2013.

2. G.L. Eichhorn, Inorganic Bio chemistry; Volumes1and2, 2ndEd., Elsevier Scientific Publishing Company, NewYork,1975.

3. F.A. Cotton and G.Wilkinson, Advanced Inorganic Chemistry; 6thEd., John Wiley and Sons ,NewYork,1999.

4. R.C. Mehrotra and A.Singh, Organometallic Chemistry; 2nd Ed.,New Age International Ltd. NewDelhi,2014.

5. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals; 3rdEd., JohnWiley and Sons, NewYork,2001.

Web- Resources:

1. https://guides.loc.gov
2. https://chem..libretexts.org

Course Outcomes:

On completion of the course the learner will be able

Course Outcomes:

On completion of the course the learner will be able

CO 1: Apply the basic principles in bioinorganic chemistry.

CO 2: Illustrate the role of metal in biological system and their function.

CO 3: Describe the structural and functional relationship, mechanisms and importance of metalloenzymes.

CO 4: Tabulate the role of metal ions in enzymes involved in acid-base reactions.

CO 5: Explain the role of metal ions that are involved in electron –transfer reactions in biological systems.

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	M	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	M	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester-II / Core Course-V	**PHYSICAL METHODS IN CHEMISTRY -I**	**Course Code : PGQG**
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Understand the principles of molecular spectroscopy. • Study UV, NMR and IR spectroscopy of organic compounds. • Learn the ESR, ORD and Mass spectroscopy of organic compounds. • Know the effect of X-ray, electron, neutron diffractions of compounds. • Illustrate the transitions through electronic spectroscopy.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**PRINCIPLES OF MOLECULAR SPECTROSCOPY** Interaction of electromagnetic radiation with molecular systems – time evolution of the systems under radiation–Einstein transition probability for induced absorption and spontaneous and stimulated emission – transition moment and oscillator strength. Microwave spectroscopy– rotational spectra of diatomic molecules, rigid and non-rigid rotors – intensity of spectral lines – effects of isotopic substitution –microwave spectra of poly atomic molecules– linear and symmetric top molecules–infrared spectra–diatomic molecules, simple harmonic and anharmonic oscillators–diatomic vibrating rotator rotation – vibration spectrum of carbon monoxide– interaction of rotation and vibration(breakdown of Born-Oppenheimer approximation) – influence of the rotation on the spectrum of poly atomic molecules, linear and symmetric top molecules, parallel and perpendicular vibrations–influence of nuclear spin. Raman spectra–rotational Raman spectra of linear and symmetric top molecules– vibrational Raman spectra– rotational fine structure– electronic spectra of diatomic molecules–vibrational coarse structure– intensity of vibrational lines in electronic spectra– rotational fine structure – fortrat diagram.	**(18 Hrs)**
Unit - II	**NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY** ^{1}H NMR Spectroscopy – multiplicity – coupling constant – spin-spin	**(18 Hrs)**

	splitting –vicinal and germinal coupling constants Karplus equation long range coupling constants, influence of stereo chemical factors on chemical shift of protons. Simplification of complex spectra – double resonance techniques, shifts reagents–chemical spin decoupling of rapidly exchangeable protons(OH,SH,COOH,NH,NH2)–an elementary treatment of NOE phenomenon. ^{13}CNMR Spectroscopy–broadband decoupling– off resonance decoupling– chemical shifts of common functional groups– FT NMR and its importance DEPT spectra–identification of small compounds based on NMR data– 2D techniques:^{1}H–^{1}HCOSY,^{1}H–^{13}CHETCOSY–NOESY.	
Unit- III	**UV-VISIBLE AND IR SPECTROSCOPY** UV- Visible spectroscopy– introduction–instrumentation, sampling techniques- Woodward-Fieser and Scott's rules for conjugated dienes and polymers, ketones, aldehydes, α,β-unsaturated acids, esters, nitriles, an amides–differentiation of geometrical isomers and positional isomers–di subsitituted benzene derivatives–study of steric effect in aromaticity. Infrared spectroscopy– Introduction– instrumentation, sampling techniques– factors influencing group frequencies – quantitative studies – hydrogen bonding (inter molecular and intra molecular).	**(18 Hrs)**
Unit - IV	**ESR, ORD AND MASS TECHNIQUES** ESR – basic principles – comparison between ESR and NMR spectra – hyperfinesplitting–applications to organic free radicals. Optical rotatory dispersion and circular dichroism – introduction to theory and terminology– cotton effect– ORD curves–axial halo ketone rule and its applications– the octant rule–its applications applications of ORD to determine absolute configuration of monocyclic ketones – comparison between ORD and CD–their interrelationships. MassSpectrometry– instrumentation– resolution– ESI, EI, CI and FAB methods–basepeak, isotopic peaks, metastable peaks importance of metastable peaks, parent peak, recognition of molecular ion peak–fragmentation – general rules – pattern of fragmentation for various classes of compounds, McLafferty rearrangement– nitrogen rule. Application of UV, IR, NMR and mass spectroscopy– structural elucidation of organic compounds– (minimum 15problems should be worked out).	**(18 Hrs)**
Unit - V	**X-RAY DIFFRACTION** X- Ray diffraction by single crystal method – space groups – systematic absences in X-ray data and identification of lattice types, glide planes and screw axes–X-ray intensities – structure factor and its relation to	**(18 Hrs)**

	intensity and electron density– phase problem– structure solution by heavy atom method and direct method–determination of absolute configuration of molecules–a brief account of Cambridge Structural Database (CSD) and Protein Data Bank(PDB). Electron diffraction by gases – scattering intensity vs. scattering angle, Wierl equation–measurement techniques.	
Unit VI **Self Study**	Comparison of X-ray, electron and neutron diffraction methods. Methods of simplifying complex NMR spectra- NMR shift reagents and high field NMR	

Text Book:

1. C.N. Banwell, Fundamentals of Molecular Spectroscopy; 4th Ed., McGraw Hill Education, Noida, 1994.
2. B.P. Straughan and S.Walker, Spectroscopy; Vol.3, Halstead Press, Sydney,1978.
3. G.M. Barrow, Introduction to Molecular Spectroscopy; McGraw Hill, NewYork, 1964.

Reference Books:

1. W.Kemp,Organic Spectroscopy;3rd Ed.,Palgrave,NewYork,1991.
2. J.R.Dyer, Applications of Absorption Spectroscopy of Organic Compounds, PHIL earning, NewDelhi, 2009.
3. Y.R.Sharma, Elementary Organic Spectroscopy–Principles and Chemical applications; S.Chand, New Delhi, 1992.
4. P.S.Kalsi, Spectroscopy of Organic Compounds; 6th Ed., New Age International Publishers, NewDelhi,2004.
5. W.Clegg, Crystal Structure Determination; Oxford University press, UK, 1998.

Web - Resources:

1. https://chemistry.snu.edu.in
2. https://libretexts.org

Course Outcomes:

On completion of the course the learner will be able

CO 1: Describe the selection rule for Infrared -active transitions.

CO 2: Compare and contrast atomic and molecular spectra.

CO 3: Apply spectral concepts to solve the problems, elucidate structures of simple compounds

CO 4: Perform the most commonly used NMR experiment to interpret and document their results.

CO 5: Gain knowledge of the fine structure of ESR absorption, Hyperfine structure, Double resonance in ESR and techniques of ESR spectroscopy.

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-II / Core Practical-III	**ORGANIC CHEMISTRY II (P)**	Course Code: **PGQHY**
Instruction Hours: 6	Credits: 3	Exam Hours: 6
Internal Marks -40	External Marks-60	Total Marks: 100

Course Objectives	• Carry out the qualitative analysis of an organic mixture. • Perform the preparation of organic compounds.	
	CONTENT	**HOURS**
	1. QUANTITATIVE ANALYSIS OF ORGANIC COMPOUNDS Estimation of phenol, aniline, ketone, glucose, nitrobenzene, saponification value of an oil and iodine value of oil. **2. PREPARATION OF ORGANIC COMPOUNDS (DOUBLE STAGE)** a. *p*-Bromoacetanilide from aniline(acetylation and bromination) b. Acetyl salicylicacid from methyl salicylate(hydrolysis and acetylation) c. 1,3,5-Tribromobenzene from aniline (bromination, diazotization and hydrolysis) d. *p*-Nitro aniline from acetanilide (nitration and hydrolysis) e. Benzilic acid from benzoin (rearrangement) f. *p*-Aminobenzoic acid from p-nitrotoluene (oxidation and reduction) g. Benzanilide from benzophenone (rearrangement) h. *p*-Bromoaniline from acetanilide (bromination and hydrolysis) i. *m*-Nitroaniline from nitrobenzene(nitration and reduction) 1,2,4-Triacetoxy benzene from hydroquinone (oxidation and acylation)	**6 Hours per Week**

Course Outcomes:
On completion of the course the learner will be able to

CO 1: Study the estimation of chemicals, which provide knowledge about the purity and concentration
CO 2: Expertise in organic synthetic methods

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

S- Strongly Correlated
M- Moderately Correlated
W- Weakly Correlated
N- No Correlation

Semester-II / Core Practical- IV	**INORGANIC CHEMISTRY II(P)**	Course Code: **PGQIY**
Instruction Hours: 6	Credits: 3	Exam Hours: 6
Internal Marks -40	External Marks-60	Total Marks: 100

Course Objectives	• Carry out the titrimetric and gravimetric analyses. • Perform the preparation of compounds	
	CONTENT	**HOURS**
	1. Titrimetry and Gravimetry A mixture of solution(s) should be given for Estimation of Cu(V) and Ni(G) Cu(V) and Zn(G) Fe(V) and Zn(G) Fe(V) and Ni(G) ZnI and Cu(G) **2 . Preparation of complexes** 1.Tris(thiourea) copper(I) chloride 2.Tetraammine copper(II) sulphate 3.Potassium tri oxalate ferrate 4.Potassium tri 28xalate aluminate(III) 5.Potassium tri 28xalate chromate(III) 6.Hexammine cobalt(III)chloride	**6 Hours per Week**

Reference Books:

1. A.I.Vogel, Text Book of Quantitative Inorganic Analysis; 6thEd., Longman, NewDelhi, 2000

Course Outcomes:
On completion of the course the learner will be able to
CO 1: Develop skills in systematic qualitative analysis of mixture.
CO 2: Get training in the complexometric titration.
CO 3: Gain skill to prepare inorganic complexes.

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

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester-II / Elective Course-I	NON–COVENTIONAL ENERGY SOURCES	Course Code: PGQE1
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Understand the various types of energy sources. • Learn about the solar energy • Introduce the importance of wind energy & fuel cells. • Acquire knowledge about bio energy. • Know the differential 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, Vertical Wind Mills – Advantages & Disadvantage of Wind energy. Fuel cells – Introduction - Working of Fuel Cells - 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, PHIL earning, 2005.
3. N.K Bansal, Non–Conventional Energy Source, Vikas Publishinghouse.
4. B.H. Khan, Non Conventional Energy Sources, McGraw Hill Publications,3rdEdition

Reference Books:

1. Roger H.Charlier, Charles W. "Ocean Energy- Tide and Tidal Power" ISBN: Library of Congress Control Number :2008929624_c Springer-Verlag Brerlin Heidelberg 2009.
2. John F.Walker& N.Jenkins, "Wind Energy Technology", John Willey and Sons Chichester,U.K–1997.
3. T.H. Taylor Alternate Energy Sourcesby. Adam Hilger Ltd,Bristol

Web- Resources:

https://www.topfreebooks.org

Course Outcomes:

On completion of the course the learner will be able

CO 1: To ensure the students understand the basic concept of energy.

CO 2: Understand the solar devices such as solar cooker, solar water heater.

CO 3: Get awareness about the wind energy and conversion to the generation of power.

CO 4: An introduction of composition of biogas and generation of power.

CO 5: Study about the principles of 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	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester- III / Core Course-VI	ORGANIC CHEMISTRY II	Course Code: PGQJ
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 – Creating	
Course Objectives	• To understand the nucleophilic and electrophilic substitution reactions. • To learn the addition and elimination reactions. • To introduce advanced level study in addition reactions. • To study a variety of heterocycles. • To know the chemistry of terpenoids, steroids and alkaloids.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**NUCLEOPHILIC SUBSTITUTION REACTIONS** Aliphatic nucleophilic substitution–mechanisms–S_{N1}, S_{N2}, S_{Ni}– ion-pair in S_N1 mechanisms– neighbouring group participation, non – classical carbocations–substitutions at allylic and vinylic carbons. Reactivity–effect of structure, nucleophile, leaving group and stereo chemical factors–correlation of structure with reactivity– solvent effects –rearrangements involving carbocations – Wagner-Meerwein and dienone-phenol rearrangements. Aromatic nucleophilic substitutions – S_N1, S_NAr, Benzyne mechanism – reactivity orientation–Ullmann, Sandmeyer and Chichibabin reaction–rearrangements involving nucleophilic substitution–Stevens– Sommelet-Hauser and von – Richter rearrangements.	**(18 Hrs)**
Unit - II	**ELECTROPHILIC SUBSTITUTION REACTIONS** Aromatic electrophilic substitution reaction orientation, reactivity and mechanisms based on transition state theory with suitable reactions – substitutions in thiophene and pyridine – N-oxide – quantitative treatment of the structural effects on reactivity. Substituent effects–origins of Hammett equation – principles of Hammett correlation–effect of structure on reaction mechanisms Hammett parameters – and, modified forms of Hammett equation, Taft Equation. Aliphatic electrophilic substitution – S_E2, S_Ei and S_E1 mechanisms – diazonium coupling reactions–metals as electrophile in substitution reactions and decomposition of diazonium salts.	**(18 Hrs)**

Unit- III	**ADDITION AND ELIMINATION REACTIONS** Addition to carbon-carbon multiple bonds – electrophilic, nucleophilic and free radical additions–orientation of the addition – stereo chemical factors influencing the addition of bromine and hydrogen bromide,hydroxylation,1,2-dihydroxylation–hydro boration leading to formation of alcohols – oxidation and ozonolysis. Addition to carbonyl and conjugated carbonyl systems – mechanism – Grignard reagents–1,2-and1,4-additions (lithium dimethyl cuprate)– addition to carbon-oxygen double bond– Benzoin, Knoevenagel, Stobbe, Darzens glycidic ester condensation and Reformatsky reactions. Elimination reactions–mechanisms;E1,E2,E1cB–stereo chemistry of elimination, Hofmann's and Zaitsev's rules – competition between elimination and substitution – pyrolytic *cis*-elimination, Chugaev reaction – examples such as dehydration, dehydro halogenation, Hofmann degradation, Cope elimination-Bredt's rule with examples.	**(18 Hrs)**
Unit - IV	**HETERO CYCLES** Nomenclature: Trivial, systematic and replacement nomenclature –non-aromatic hetero cycles – synthesis of tetra hydro furans– pyrrolidines – tetrahydro pyrans – piperidines. Synthesis and reactivity of hetero cycles: aziridines – oxiranes – thiiranes – azetidines – oxetanes – oxazoles – imidazoles – thiazoles – isooxazoles. Synthesis and reactivity of aromatic hetero cycles: pyrazoles–isothiazoles–triazoles–pyrimidines–purines–triazines–pyridazines–pyrazines.	**(18 Hrs)**
Unit - V	**NATURAL PRODUCTS** Terpenoids: introduction – biosynthesis of menthol, camphor – total synthesis: Takasago synthesis of menthol, Corey's synthesis of longifolene, Curran's synthesis of hirsutene. Steroids: introduction– partial synthesis of androsterone and testosterone (from Cholesterol) – total synthesis: Johnson's synthesis of progesterone and Vollhardt's synthesis of estrone. Alkaloids: introduction – biosynthesis of nicotine, camptothecin–total synthesis: Corey's synthesis of epibatidine, Comin's asymmetric synthesis of Camptothecin and Woodward's synthesis of reserpine**.**	**(18 Hrs)**
Unit VI Self Study	Hydrolysis of alkyl halides, acyl halides, anhydrides, carboxylic esters and amides.	

Text Book:

1. T.H.E. Lowry and K.S. Richardson, Mechanism and Theory in Organic Chemistry; 3rdEd.,Benjamin- CummingsPublishing,USA,1997.

2.J.March and M.B. Smith, Advanced Organic Chemistry: Reactions, Mechanisms and Structure,6thEd.,Wiley,NewYork,2007.

3. R.K.Bansal, Heterocyclic Chemistry; 3rdEd., Wiley Eastern Ltd, NewDelhi,1999.

Reference Books:

1. S.H. Pine and J.B. Hendrickson, D.J. Cram and G.S. Hammond, Organic Chemistry; 5thEd., McGrawHill, Noida,1987.
2. R.K.Bansal, Reaction Mechanismin Organic Chemistry; Tata McGrawHill, Noida,1990.
3. Androsterone and Testosterone: J.Chem. Soc. Perkin Trans.I; 1986,117.
4. E.J.Corey,andX-M.Cheng, The Logic of Chemical Synthesis;1stEd.,Wiley-Interscience,NewYork,1995.
5. J.Clayden,N.Greeves,S.Warren,andP.Wothers,OrganicChemistry,2ndEd.,OxfordUniversity Press,UK,2012.

e- Resources:

1. https://www.elsevier.com
2. https://www.amazon.in

Course Outcomes:

On completion of the course the learner will be able to

CO 1: Acquire knowledge about nucleophilic substitution reactions.

CO 2: Learn nomenclature synthesis and reactivity of hetero cyclic compounds

CO 3: Elucidate the structure and synthetic route of heterocyclic compounds

CO 4: Learn the different types of alkaloids, glycosides and terpenes etc.. and their chemistry and medicinal importance.

CO 5: Learn advanced methods of structural elucidation of compounds of natural origin.

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 / Core Course-VII	PHYSICAL CHEMISTRY II	Course Code: PGQK
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 - Creating	
Course Objectives	• Study the applications of quantum chemistry and group theory. • Quantum chemistry uses high- level mathematics as a tool to understand atomic and molecular structure and properties, as well as chemical reactivity. • Understand and use the term angular momentum in many electron systems. • Learn electrochemistry, adsorption and classical thermodynamics. • Familiar with the concept of surface chemistry.	
UNIT	CONTENT	HOURS
Unit -I	**QUANTUM CHEMISTRY - II AND GROUP THEORY** Applications of wave mechanics–the harmonic oscillator, rigid rotator hydrogen and hydrogen like atoms – shapes and nodal properties of orbitals space quantization – approximation methods – methods of variation, application hydrogen and helium atoms–perturbation method – non-degenerate systems helium atom –effective nuclear charge. Electron spin – many electron atoms – Pauli's principle – Slater determinants – atomic structure calculation–self-consistent field method– Hartree- Fock method for atoms – angular momentum in many electron systems – spin-orbit interaction, L-Sand j- j coupling schemes. Symmetry adapted linear combinations (SALC) – vibrational spectra–symmetry properties of normal molecules – symmetry coordinates – selection rules for fundamental vibrational transition–IR and Raman activity of fundamentals in CO_2, H_2O, N_2F_2–the rule of mutual exclusion and Fermi resonance.	**(18 Hrs)**
Unit - II	**ELECTROCHEMISTRY – I** Ion transport in solution – migration, convection and diffusion – Fick's laws of diffusion conduction–Debye- Huckel theory–ionic atmosphere –Debye - Huckel- Onsager equation – verification and extension–Debye- Falken hagen effect and Wien effect, Debye-Huckel limiting law – activity coefficients and ionic strength–Bjerrum model. The electrode – electrolyte interface – electrical double layer and multi layers – theories–electro capillary curves – Lipmann equation and Lipmann potential. Electro kinetic phenomena – classification –Tiselius method of separation of proteins–membrane potential – electro catalysis.	**(18 Hrs)**

Unit- III	**ELECTROCHEMISTRY – II** Dynamics of electron transfer – Marcus theory – tunneling – the rate of charge transfer – current density–Butler - Volmer equation –Taft equation–polarization and over voltage – mechanism of hydrogen evolution and oxygen evolution reactions. Principles of electro deposition of metals – corrosion and passivity – Pourbaix and Evans diagrams – methods of protection of metals from corrosion. Power storage systems – fuel cells–construction and functioning – applications - Photo voltaic cells.	**(18 Hrs)**
Unit - IV	**SURFACE CHEMISTRY AND CHEMICAL KINETICS - II** Surface phenomena–Gibbs adsorption isotherm – solid - liquid interfaces – contact angle and wetting–solid-gas interface – physisorption and chemisorption–Langmuir, BET isotherms–surface area determination. Kinetics of surface reactions involving adsorbed species–Langmuir-Hinshelwood mechanism, Langmuir - Rideal mechanism – Rideal – Eley mechanism–some interfacial aspects on micelles ,rever semicelles, micro emulsions and membranes. Application of ARRT to solution kinetics –effect of solvent and ionic strength, influence of pressure on rates in solution–enzyme catalysis – mechanism of single substrate reactions – Michaelis – Menten law – acidity functions–kinetics of processes in micellar and rever semi cellar systems.	**(18 Hrs)**
Unit - V	**CLASSICAL THERMODYNAMICS** Third law thermodynamics–significance–Nernst heat theorem and other forms of stating the third law – thermodynamic quantities at absolute zero – apparent exceptions to the third law. Thermodynamics of systems of variable composition–partial molar properties - Chemical potential – relationship between partial molar quantities–Gibbs - Duhem equation and its applications (the experimental determination of partial molar properties not included). Thermodynamic properties of real gases – fugacity concept – calculation of fugacity of real gas – activity and activity coefficient – concept – definition – standard states and experimental determinations of activity and activity coefficient of electrolytes. Thermodynamics of irreversible processes: coupled flow – Onsager's reciprocal relations–entropy production.	**(18 Hrs)**
Unit VI Self Study	Zeroth, first, second and third laws of thermodynamics properties that emerge out these laws.	

Text Book:

1. A.K. Chandra, Introductory Quantum Chemistry; 4thEd., Tata Mc Graw Hill, Noida, 1994.
2. D.A. Mcquarrie, Quantum Chemistry; University Science Books, Herndon,2008.
3. R.K. Prasad, Quantum Chemistry; 4thEd., New Age International Publishers, New Delhi,2014.

Reference Books:

1. K.J. Laidler, Chemical Kinetics; 3rdEd., PrenticeHall, NewJersey,1987
2. L. Antropov, Theoretical Electro chemistry; University Press of the Pacific, USA,2001.
3. J.O'M Bockris and A.K.N. Reddy, Modern Electrochemistry; Vol.1and2,2ndEd., Plenum Press, NewYork, 1998.
4. G.W. Castellan, Physical Chemistry; Narosa, NewDelhi, 1986.
5. M. Mortimer and P.G. Taylor, Chemical Kinetics and Mechanism; 1stEd. Royal Society of Chemistry, UK, 2002.

Web- Resources:

1. https://www.nature.com
2. https://www.amazon.in

Course Outcomes:

On completion of the course the learner will be able to

CO 1: Learn the basic principles and concept of quantum mechanics.

CO 2: Learn Debye Huckel onsager equation and Debye- Falkenhagen effect and we in effect to different electro Chemical system.

CO 3: Describe the main components of power storage system.

CO 4: Provide knowledge on fundamental understanding of chemical kinetics and to establish a relationship between the rate of reaction and the concentration of the reactants (the rate law, or rate equation).

CO 5: Acquire knowledge about classical thermodynamics.

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	W	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	M	S	M	S	S	S	S	S	S

S- Strongly Correlated
M- Moderately Correlated
W- Weakly Correlated
N- No Correlation

Semester- III /Core Practical -V	PHYSICAL CHEMISTRY PRACTICAL I	Course Code: PGQLY
Instruction Hours: 6	Credits: 6	Exam Hours: 6
Internal Marks - 40	External Marks - 60	Total Marks: 100

Course Objectives	• To perform the various techniques of physical chemistry experiments.	
	CONTENT	**HOURS**
	Any ten experiments (to be decided by the course teacher) out of the following. a. Kinetics-acid hydrolysis of ester–comparison of strengths of acids. b. Kinetics-acid hydrolysis of ester–determination of energy of activation (Ea). c. Kinetics - saponification of ester – determination of ethyl acetate by conductometry. d. Kinetics - persulfate – iodine reaction – determination of order, effective of ionic strength on rate constant. e. Determination of molecular weight of substance by transition temperature method. f. Determination of molecular weight of substances by Rast method. g. Determination of Critical Solution Temperature (CST) of phenol - water system and effect of impurity on CST. h. Study of phase diagram of two components forming a simple eutectic. i. Study of phase diagram of two components forming a compound. j. Study of phase diagram of three components system. k. Determination of molecular weight of substances by cryoscopy. l. Determination of integral and differential heat of solutions by colorimetry. m. Polymerization - rate of polymerization of acrylamide. n. Distribution law – study of Iodine-Iodine equilibrium. o. Distribution law – study of association of benzoic acid in benzene. p. Adsorption – oxalic acid/ acetic acid on charcoal using Freundlich isotherm	**6 Hours per Week**

Reference Books:

1. B.P.Levitt, Findlay's Practical Physical Chemistry;9thEd., Longman,1985.
2. J.N. Gurtuand R.Kapoor, Advanced Experimental Chemistry; Vol.1-Physical, S.ChandandCo., NewDelhi,1987.

Course Outcomes:
On completion of the course the learner will be able to

CO 1: Draw the phase diagram 3 component systems and analyze it
CO 2: Determine the kinetics of the reactions
CO 3: Predict the concentration of two analytes in a mixture

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	M	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

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester-III / Elective Course- II	INDUSTRIAL CHEMISTRY	Course Code: PGQE2
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks -75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Understand and develop efficacy in planning, designing, production processing and marketing • Study water testing treatment and petroleum refining. • Acquire in depth knowledge of basic and applied area of industrial chemistry. • Know the industrial production of soaps, detergents and perfumes. • Learn the process of photography.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**BASIC IDEAS ABOUT UNIT OPERATION** Basic ideas about unit operation – Flowcharts – Chemical conversion – Batch versus continuous processing – chemical process selection – design – chemical process control – chemical process economics – market evaluation – plant location –management in productivity and creativity. Research & development and its role in chemical industries**.**	**(18 Hrs)**
Unit - II	**PETROLEUM AND DETERGENTS** Water conditioning for chemical factories – reuse – methods of conditioning demineralization – precipitation – desalting – industrial and sewage waste water treatment. 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 manufacture of paper – speciality paper– paper stock– structural boards. Plastics – manufacture – resin – manufacturing processes–condensation polymerization – manufacture of laminates and other derivatives –	**(18 Hrs)**

	Hexamethylene tetramine plastics – vinyl esters. Wood conversions – Hydrolytic wood – Phenolic treatment wood – chip wood and their manufacture & advantages – fire retarding wood**.** **(18Hrs)**	
Unit - IV	**PERFUMES** Introduction – Definition - uses and economics -.production of natural and synthetic perfumes – Flower perfumes – Fruit flavours – artificial flavours. **(18Hrs)**	**(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. **(18Hrs)**	**(18 Hrs)**

Text Book:

1. Charkarbharthy BN, Industrial Chemistry, Oxford and IBH Publishing.Co.1stEdition.NewDelhi.
2. Danielsetal., Experimental Physical chemistry, 7thEd, NewYork,McGrawHill,1970.
3. Sharma BK**,** Industrial Chemistry, geol Publishing House, Meerut.

Reference Books:

1. Norris Shreve.R. and Joseph.A.BrinkJr-Chemical process Industries–.McGrawHill, International Book Company,London.
2. BrainA.C.S.Remhold-Production and properties of Industrial Chemicals – NewYork
3. Burgh, A Fermentation industries – Interscience, New York.
4. Gilbert .J. Handbook of Technology and Engineering–,Van Nostr and Reinhold, London.
5. Guthrie. V-Petroleum products Handbook. McGrawHill, Tokyo.

Web- Resources:

1. https://www.essentialchemicalindustry.org
2. https://www.tandfonline.com

Course Outcomes:

On completion of the course the learner will be able to

CO 1: Identify and understand the unit operations involved in a process

CO 2: Design common heat exchangers like double pipe and shell & tube to determine relevant design parameters

CO 3: Understand the commercial processes used for there fining and processing of natural gas and crude petroleum

CO 4: Solve materials and energy balances alone and simultaneously on chemical process system

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	M	M	S	S
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	M

S- Strongly Correlated

M- Moderately Correlated

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 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
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 B12, 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 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**.**	**(18 Hrs)**
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	GREEN CHEMISTRY	Course Code: PGQE3
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Study the basic principles and alternative materials of sustainable green chemistry. • Learn the synthesis of ionic liquids and phase transfer catalysis. • Impart depth knowledge in supported catalysis and bio catalysis. • Gain knowledge about the alternative synthesis, reagent and reaction condition of green chemistry. • Focus on the application of greener routes to improve industrial processes and to produce important products.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**INTRODUCTION TO GREEN CHEMISTRY** Green chemistry – relevance and goals, Anastas, twelve principles of green chemistry - Tools of green chemistry, alternative starting materials, reagent, catalysts, solvent, and processes with suitable examples.	**(18 Hrs)**
Unit - II	**MICROWAVE ACTIVATION ORGANIC SYNTHESIS (MAOS)** Microwave activation – advantage of microwave exposure – specific effects of microwave – Neat reactions – solid supports reactions – Functional group transformations – condensations reactions – oxidations - reductions reactions – multi - component reactions.	**(18 Hrs)**
Unit- III	**IONIC LIQUIDS AND PTC** Introduction – synthesis of ionic liquids – physical properties – applications in alkylation–hydro formylations – expxidations – synthesis of ethers – Friedel craft reactions – Diels – alder reactions – knoevengel condensations – Wittig reactions – Phase transfer catalyst – synthesis – applications.	**(18 Hrs)**
Unit - V	**ALTERNATIVE SYNTHESIS, REAGENTS AND REACTION CONDITIONS** A photo chemical alternative to Friedel – crafts reactions – Dimethyl carbonate as a methylating agent - the design and applications of green oxidants-supercritical carbon dioxide for synthetic chemistry**.**	**(18 Hrs)**

Text Book:

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

Reference Books:

1. Paul T.Anastas& Tracy C.Williamson, Green chemistry – Designing chemistry for environment– Second Edition(1998).
2. Paul T.Anastas &Tracy C.Williamson. Green chemistry –Frontiers in benign chemicals synthesis and processes-Oxford University Press(1998).
3. Rashmi Sanghi &M.M. Srivastava, Green chemistry – Environment friendlylternatives - Narora PublishingHouse,(2003)

Web - Resources:

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

Course Outcomes:

On completion of the course the learner will be able to

CO 1: Explain Green chemistry and sustainability which relates to problems of societal concern.
CO 2: Designed of chemical products and processes that reduce or eliminate the use and generation of hazardous substances.
CO 3: Describe Green chemistry and sustainability developments that affect society, the environment and economic development.
CO 4 : Analyze a process and identify parameters that make environmentally friendly/ sustainable /green.
CO 5: Integrate, synthesize, and apply knowledge of the relationship between science and technology and societal issues in both focused and broad interdisciplinary contexts.

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	M	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 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
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 Modelling 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 of action of drugs – metabolism of drugs - Absorption of drugs – Assay of drugs.	**(18 Hrs)**

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- IV / Core Course-VIII	**PHYSICAL METHODS IN CHEMISTRY II**	**Course Code: PGQM**
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks - 75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
Course Objectives	• Outline the theory of electronic spectroscopy of metal complexes. • Derive and apply spectroscopic transition rules for electronic transition in atoms and molecules. • Study in detail IR, Raman and NMR of inorganic compounds. • Learn the EPR, Mossbauer and magnetic properties of metal complexes. • Understand principles and applications of Mossbauer Spectroscopy.	
UNIT	**CONTENT**	**HOURS**
Unit -I	**ELECTRONIC SPECTROSCOPY** Microstates, terms and energy levels for d1–d9ions in cubic and square fields -intensity of bands– group theoretical approach to selection rules – effect of distortion and spin-orbit coupling on spectra– evaluation of 10Dq and for octahedral complexes of cobalt and nickel – applications to simple coordination compounds–charge transfer spectra–electronic spectra of $[Ru(bipy)3]^{2+}$. Optical rotator dispersion and circular dichroism and magnetic circular dichroism– applications to metal complexes.	**(18 Hrs)**
Unit - II	**INFRARED AND RAMAN SPECTROSCOPY** Vibrations in simple molecules (H_2O, CO2) and their symmetry notation for molecular vibrations–group vibrations and the limitations–combined uses of IR and Raman spectroscopy in the structural elucidation of simple molecules like N2O, ClF3, $NO3^-$, $ClO4^-$ effect of coordination on ligand vibrations–uses of groups vibrations in the structural	**(18 Hrs)**

	elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate and dimethyl sulfoxide. Effect of isotopic substitution on the vibrational spectra of molecules – vibrational spectra of metal carbonyls with reference to the nature of bonding –geometry and number of C-O stretching vibrations (group theoretical treatment)–applications of Raman spectroscopy–resonance Raman spectroscopy.	
Unit- III	**NMR SPECTROSCOPY** Examples for different spin systems–chemical shifts and coupling constants (spin-spin coupling)involving different nuclei(^{1}H, ^{19}F, ^{31}P, ^{13}C) interpretation and applications to inorganic compounds – Effect of quadrupolar nuclei (^{2}H,^{10}B,^{11}B)on the ^{1}HNMR spectra. Systems with chemical exchange – evaluation of thermodynamic parameters in simple systems–study of fluxional behavior of molecules – NMR of paramagnetic molecules–isotropic shifts contact and pseudo-contact interactions–lanthanide shift reagents.	**(18 Hrs)**
Unit - IV	**EPR SPECTROSCOPY AND MAGNETIC PROPERTIES** Theory of EPR spectroscopy–spin densities and McConnell relationship –factors affecting the magnitude of g and A tensors in metal species – zero-field splitting and Kramers degeneracy–spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II) and Cu(II) complexes– applications of EPR to a few biological molecules containing Cu(II)and Fe(III)ions. Magnetic properties – types of magnetism – dia ,para, ferro- and antiferro- magnetism–magnetic properties of free ions– first- order Zeeman effect–second –order Zeeman effect–states KT – states <<<KT– determination of magnetic moments and their applications to the elucidation of structures of inorganic compounds–temperature independent paramagnetism – magnetic properties of lanthanides and	**(18 Hrs)**

	actinides– spin cross over in coordination compounds.	
Unit - V	**Mossbauer Spectroscopy** Isomer shifts– quadrupole splitting–magnetic interactions–applications to iron and tin compounds. NQR spectroscopy – characteristics of quadrupolar nucleus – effects of field gradient and magnetic field upon quadrupolar energy levels– NQR transitions– applications of NQR spectroscopy	**(18 Hrs)**
Unit VI **Self Study**	Interpretation of proton NMR spectra of different classes of organic compounds involving 2d correlations.	

Text Book:

1. R.S.Drago, Physica Methods in Inorganic Chemistry ; Affiliated East-West Press Pvt. Ltd., NewDelhi,2012.
2. R.S.Drago, Physical Methods in Chemistry; Saunders College Publications, Philadelphia, 1992.
3. F.A.Cotton and G.Wilkinson, Advanced Inorganic Chemistry, 6thEd., Wiley Eastern Company, NewDelhi,1999.
4. P. J.Wheatley, The Determination of Molecular Structure; 2nd Ed., Dover Publications, Mineola,1981.
5. G.J.Leigh, N.Winterton, Modern Coordination Chemistry; Royal Society of Chemistry ,UK,2002.

Reference Books:

1. W.Kemp, Organic Spectroscopy; 3rd Ed.,Palgrave ,NewYork,2011.
2. J.R.Dyer, Applications of Absorption Spectroscopy of Organic Compounds, PHIL earning, NewDelhi,2009.
3. Y.R.Sharma, Elementary Organic Spectroscopy–Principles and Chemical Applications; S.Chand and Co., NewDelhi, 1992.
4. P.S.Kalsi, Spectroscopy of Organic Compounds; 6thEd., New Age International Publishers, NewDelhi,2004.

Web- Resources:

1. https://www.elsevier.com
2. https://www.amazon.in

Course Outcomes:

On completion of the course the learner will be able to

CO 1:Explain the general features of absorption and photo electron spectra and their dependence on the sample properties.

CO 2:Able to describe molecular vibration with the interaction of matter and electromagnetic waves.

CO 3:Understand concept of NMR spectroscopy and its applications.

CO 4:Acquire knowledge about EPR spectroscopy and magnetism.

CO 5:Learn principles and applications of Mossbauer Spectroscopy.

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 / Core Course-VI	PHYSICAL CHEMISTRY PRACTICAL- II	Course Code: PGQNY
Instruction Hours: 6	Credits: 3	Exam Hours: 6
Internal Marks -40	External Marks-60	Total Marks: 100

Course Objectives	• To perform the various electrical experiments	
	CONTENT	**HOURS**
	Any **ten** experiments (to be decided by the course teacher) out of the following experiments. a. Conductometry –acid- alkali titrations. b. Conductometry – precipitation titrations. c. Conductometry – displacement titrations. d. Conductometry – determination of dissociation constant of weak acids. e. Conductometry – solubility product of sparingly soluble silver salts. f. Verification of Onsager equation- conductivity method. g. Determination of degree of hydrolysis and hydrolysis constant of a substance. h. Potentiometric titrations – acid alkali titrations. i. Potentiometric titrations – precipitation titrations. j. Potentiometric titrations– redox titrations. k. Potentiometry– determination of dissociation constant of weak acids. l. Potentiometry– determination of solubility of silver salts. m. Potentiometry–determination of activity and activity coefficient of ions. n. pH Titration of *ortho*- phosphoric acid. o. To determine the relative strength of two acids by conductance measurements. p. To determine the pH of a buffer solution using a quinhydrone electrode.	**6 Hours per Week**

Reference Books:

1. J.B.Yadav, Advanced Practical Physical Chemistry; 20th Ed., GOEL Publishing House, Krishna Prakashan Media Ltd., Chennai, 2001.
2. B.P.Levitt, Findlay's Practical Physical Chemistry ;9thEd., Longman, London, 1985.
3. J. N. Gurtur and R. Kapoor, Advanced Experimental Chemistry; Vol. 1-Physical, S.ChandandCo.Ltd,NewDelhi,1997.

Course Outcomes:

On completion of the course the learner will be able to

CO 1: Understand conductometric titrations of: Strong acid Vs. strong base (ii) Weak acid vs. strong base, (iii) Mixture of strong acid and (iv) weak acid vs strong base, Strong acid vs. weak base.

CO 2: Develop skills in Potentiometric titrations of: (i) Strong acid vs .strong base (ii) Weak acid vs. Strong base

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

S- Strongly Correlated

M- Moderately Correlated

W- Weakly Correlated

N- No Correlation

Semester- IV /Elective course-IV	**APPLIED CHEMISTRY**	Course Code: PGQE4
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks - 25	External Marks- 40	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
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	**(18 Hrs)**

	&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.	
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 Book:

1. B.K. Sharma, H.Karur, Environmental chemistry – Goel publishing House, Meerut.
2. B.K. Sharma – Industrial chemistry- Goel publishing House, Meerut.
3. Gareth Thomas, Medicinal Chemistry: An Introduction, Wiley-Inter science, 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, Academic press,2nd edition,2004

Web- Resources:

- https/pubs.acs.org
- https://www.iiserbpn

Course Outcomes:

On completion of the course the learner will be able to

CO 1: Able to work in quality control or analytical laboratories.

CO 2: Identify industrial problems related to chemistry and find solutions for them

CO 3: Gain knowledge about paints and vehicles

CO 4: Reduce waste generation, effective handlings utilization and recycling of waste

CO 5: Explain the relationship between the structure and biological activity of drug molecule.

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

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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 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
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 sinrape cases. Typing of blood. DNA finger printing or tissue identification in dismembered bodies. Blood stain son clothing. Cranial analysis (head and teeth).	**(18 Hrs)**
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. 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-V	RECENT TRENDS IN CHEMISTRY	Course Code: PGQE5
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
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)**

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Text Book:

1. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publicating Co.
2. Shikha Agarwal, Enginnering Chemistry, Cambridge UniversityPress,2015.

Reference Books:

1 Vairam etal., Engineering Chemistry,2nd edition, Wiley India Pvt Ltd., 2014.

2 Prasanth Rath, Engineering Chemistry, Cengage learning, 2015.

3 S.S.Dara, A Text Book of Engineering Chemistry, S. Chand & Co. Ltd.,

4 H.D.Gesser, Applied Chemistry, Springer Publishers. B. Sedimentary Basins of India – ONGC bulleting.

Web- Resources:

1. https://www.api.org
2. htps://www.opisnet.com.

Course Outcomes:

After successfully completing this course, students will be able to

CO 1: Provide perspectives on future Nano chemistry developments
CO 2: Follow new developments in material application field.
CO 3: Explain importance of materials in materials science and scientific field.
CO 4: A functional understanding of the field of green chemistry.
CO 5: Chemoinformatics is a rather new discipline in science. It has been described as the application 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-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 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**	
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 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.	**(18 Hrs)**
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 deoiling) Manufacture of bituments– Selection of crude oil, methods of manufacture of bituments. (distillation, solvent).	**(18 Hrs)**

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

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