MASTER OF SCIENCE (CHEMISTRY)

VISION

To boldly explore and advance new chemicals frontiers in life sciences, physical sciences, medicine, energy, materials and environment sciences through visionary research and innovation.

MISSION

- To promote innovative inter-disciplinary thinking by providing educational and research opportunities between chemistry and other fields of study.
- To create a knowledge platform that supports an invent and design culture that empowers students to address and meet the challenges of global significance.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To understand theoretical concepts of chemical sciences as well as to interpret the data generated in instrumental chemical analyses.

PEO 2: To develop a sustainable career in their area of interest that enhances domain knowledge throughout their working endeavors.

PEO 3: To demonstrate leadership and to facilitate ethically advanced professionals in culture and interdisciplinary backgrounds.

PROGRAMME OUTCOMES (PO)

After completion of the programme, the graduates will be able to

PO1: Know the background of organic reaction mechanisms, complex chemical structures, and instrumental method of chemical analysis, molecular rearrangements and separation techniques.

PO2: Appreciate the importance of various elements present in the periodic table, coordination chemistry and structure of molecules using theories and instruments.

PO3: Gather attention about the physical aspects of atomic structure, dual behavior, and reaction pathways with respect to time.

PO4: Apply the potential uses of analytical, industrial, medicinal and green chemistry.

PO5: Carry out experiments in the area of organic, inorganic and physical fields with better analytical perception.

PROGRAMME SPECIFIC OUTCOME (PSO)

After completion of the programme, the graduates will be able to

PSO 1: Apply the domain knowledge to appreciate the theoretical aspects for applications in energy, environment, materials and medicine.

PSO 2: Utilize the contextual knowledge of chemistry to function effectively as an individual as well as a leader in multidisciplinary environments.

PSO 3: Pursue legal research and utilize domain knowledge persuasively to resolve complex problems and develop resolution skills in various environments.

PSO 4: Cogent a research oriented learning that develops analytical and integrative cognition.

PSO 5: Gain specialized knowledge and practical training to address contemporary problems in academia and industry considering the societal needs for sustainability.

REGULATIONS

ELIGIBILITY

A candidate who has passed B.Sc., Degree Examination with Branch IV Chemistry as main subject of study of this university or any of the B.Sc., degree examination with specialization such as Industrial chemistry, Polymer Chemistry, Applied Chemistry, Pharmaceutical Chemistry or any other specialization in Chemistry of some other University accepted by the syndicate as equivalent thereto, subject to such condition as may be prescribed therefore shall be permitted to appear and qualify for the M.Sc., degree in Chemistry after a course of study of two academic years.

DURATION OF THE PROGRAMME

The course shall extend over a period of two years comprising of four semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed 8 semesters.

M.Sc., SCHEME OF EXAMINATION

Subject Code	Subject	Hours of Instruction	Exam Duration (Hours)	Max Marks			Credit Points
				CA	CE	Total	
FIRST SEMESTER							
Part A							
18PCHM101	Core I: Organic Chemistry I	5	3	25	75	100	5
18PCHM102	Core II: Inorganic Chemistry I	5	3	25	75	100	5
18PCHM103	Core III: Physical Chemistry I	5	3	25	75	100	4
18PCHM104	Core IV: Spectroscopy	4	3	25	75	100	4
18PCHMP101	Core Practical I: Organic Practical I	5	6	40	60	100	3
18PCHMP102	Core Practical II: Inorganic Practical I	5	6	40	60	100	3
Non Credit							
18PLS101	Career Competency Skills I	1	-	-	-	-	-
Total		**30**				**600**	**24**
SECOND SEMESTER							
Part A							
18PCHM201	Core V: Organic Chemistry II	5	3	25	75	100	5
18PCHM202	Core VI: Inorganic Chemistry II	5	3	25	75	100	5
18PCHM203	Core VII: Physical Chemistry II	4	3	25	75	100	4
	Elective I	4	3	25	75	100	4
18PCHMP201	Core Practical III: Organic Practical II	5	6	40	60	100	3
18PCHMP202	Core Practical IV: Physical Practical I	4	6	40	60	100	3

Part B							
18PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non-Credit							
18PLS201	Career Competency Skills II	1	-	-	-	-	-
	Total	**30**				**700**	**26**
THIRD SEMESTER							
PART – A							
18PCHM301	Core VIII: Organic Chemistry III	6	3	25	75	100	5
18PCHM302	Core IX: Inorganic Chemistry III	6	3	25	75	100	5
	Elective II	4	3	25	75	100	4
18PCHMP301	Core Practical V: Inorganic Practical II	5	6	40	60	100	3
18PCHMP302	Core Practical VI: Physical Practical II	5	6	40	60	100	3
18PPHCHI301	IDC I: Solid State Physics	4	3	25	75	100	4
	Total	**30**				**600**	**24**
FOURTH SEMESTER							
PART – A							
18PCHM401	Core X: Analytical Chemistry	5	3	25	75	100	5
18PCHM402	Core XI: Physical Chemistry III	5	3	25	75	100	5
18PCHPR401	Project & Viva –Voce	5	-	50	150	200	6
	Total	**15**				**400**	**16**
					Grand Total	**2300**	**90**

Elective I

The department offers the following three subjects as elective courses for second semester

Paper code	Semester	Paper name
18PCHEL201	II	Elective I: Polymer Chemistry I
18PCHEL202	II	Elective I: Bio-inorganic chemistry I
18PCHEL203	II	Elective I:Principles and applications of drug design and discovery

Elective II

The department offers the following three subjects as elective courses for third semester

Paper code	Semester	Paper name
18PCHEL301	III	Elective II: Photochemistry
18PCHEL302	III	Elective II: Bio-inorganic chemistry II
18PCHEL303	III	Elective II: Polymer Chemistry II

For course completion:

- Students shall opt two Elective subjects.
- Students shall opt one IDC in third semester.
    - Students shall complete one Value Education in Second Semester.

TOTAL CREDIT DISTRIBUTION

Subject	Total Marks		Credits
Part A			
Core Subjects	6×100	600	8×5=40
Core Subjects	5×100	500	3×4=12
Elective Subjects	2×100	200	2×4=08
Core Practicals	6×100	600	6×3=18
Inter Disciplinary Course	1×100	100	1×4=04
Project & Viva-Voce	1×200	200	1×6=06
Part B			
Value Education: Human Rights	1×100	100	1×2=02
Total		**2300**	**90**

18PCHM101	**CORE I: ORGANIC CHEMISTRY I**	**SEMESTER - I**

COURSE OBJECTIVES:

The course aims

- To impart the basic principles of carbenes and intermediates
- To acquire knowledge about aliphatic and aromatic nucleophilic substitution reaction
- To recognize the chemistry of antibiotics, vitamins and stereochemistry
- To study the stereochemistry and aromaticity
- To learn possible reaction pathways in molecular rearrangement reactions

Credits: 5 **Total hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Basic Concepts:** Formation, stability and reactions of carbenes and nitrenes. Kinetic and thermodynamic control of chemical reactions; Methods of determining reaction mechanism - kinetic methods - Primary and secondary kinetic isotopic effects; Non -kinetic methods - Study of intermediates, product analysis, isotope labeling, Stereochemical studies and cross over experiments; Principle of microscopic reversibility; Hammond postulate. Linear free energy relationship; Hammett equation - Significance of reaction and substituent constants (σ and ρ); Taft equation.	10	CO1
II	**Aliphatic and Aromatic Electrophilic Substitution Reactions:** The arenium ion mechanism, Nitration, sulphonation, halogenation, Friedel – Crafts alkylation, acylation, Gatterman, Gatterman- Koch, Vilsmeir, Reimer – Tiemann, Kolbes reaction and diazonium coupling. Electrophilic substitution on mono-substituted benzene, orientation and reactivity – ortho, meta and para directing groups, ipso attack ortho-para ratio. SE_1 and SE_2 mechanism – keto-enol tautomerism– HVZ reaction-aliphatic diazonium coupling-acylation at an aliphatic carbon-Vilsemeyer Hack reaction at aliphatic carbon-Stork-enamine reaction.	10	CO2

III	**Vitamins and Antibiotics:** Chemistry of penicillin, streptomycin, chloromycetin, oxytetracycline and griseofulvin; Detailed chemistry and physiological action of Vitamin A, ascorbic acid, thiamin, riboflavin and elementary aspects of Vitamin B_{12}.	10	CO3
IV	**Stereochemistry and Aromaticity:** Homotopic, enantiotopic, diastereotopic H atoms, groups in organic molecules. Fischer, Newman and Sawhorse projections and their interconvertion.Optical activity in the absence of chiral carbon – biphenyls, allenes and spiranes. E – Z isomerism of olefins containing one double bond and more than one double bond. Stereospecific and stereoselective synthesis with suitable examples, asymmetric synthesis – Crams rule. Aromaticity - benzenoid, heterocyclic and non-benzenoid compounds, Huckel rule, non–aromatic (cyclooctatetraene) and anti-aromatic systems (cyclobutadiene) – annulenes, azulene.	10	CO4
V	**Molecular Rearrangements:** Nucleophilic, Electrophilic and Free radical rearrangements – memory effects, migratory aptitudes, Inter- Intra molecular rearrangement, Wagner -Meerwin, Pinacol-Pinacalone, Dienone-Phenol, Favorski, Baeyer–Villiger, Wolff, Stevens, Von – Richter, Hofmann, Schmidt and Fries rearrangements, Photo fries rearrangement.	10	CO5

Text Books:	
1	*Jerry March*. 2013. **Advanced Organic Chemistry: Reactions, Mechanisms, and Structure.** [Seventh Edition]. John Wiley & Sons, New York.
2	*Kalsi. P.S.* 2010. **Organic Reactions and Mechanisms**. [Third Edition]. New Age International Publishers, New Delhi.
3	*Ernest L. Eliel*. 1995. **Stereochemistry of Carbon Compounds**. [Second Edition]. Tata Mc. Graw-Hill Publishing Company, New Delhi.
Reference Books:	
1	*Kalsi. P.S.* 2008. **Stereo Chemistry and Mechanism through Solved Problems.** [Fourth Edition]. New Age International Publishers, New Delhi.

2	*Nasipuri. D.* 2014. **Stereo Chemistry of Organic Compounds.** [Fifth Edition]. New Age International Publishers, New Delhi.
3	*Mukherj, S.M.* and *Singh, S.P.* 1986. **Reaction Mechanism in Organic Chemistry.** [Third Edition]. Macmillan Publishers, London.
4	*Morrison boyd & Bhattacharjee.* 2010. **Organic Chemistry**. [Seventh Edition]. Prentice-Hall, New Delhi.
5	*Jagdamba Singh, L.D.S. Yadav*. 2010. **Advanced Organic Chemistry**. Revised edition. Pragati Prakashan.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the fundamental principles of organic chemistry that include chemical bonding, structural isomerism, stereochemistry, chemical reactions and mechanism.
CO2	Develop basic skills for the multi-step synthesis of organic compounds and justify a reasonable mechanism for a chemical reaction.
CO3	Recognize the structure and function of vitamins, antibiotics, penicillin, streptomycin, chloromycetin, etc.,
CO4	Interpret the concept of aromaticity and the main properties of aromatic compounds and evaluates the importance of stereochemistry in organic chemistry
CO5	Evaluate the concept of rearrangement reactions in organic compounds

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	L
CO2	L	H	M	M	H
CO3	M	L	H	H	M
CO4	M	M	L	L	H
CO5	L	H	L	M	H

H-High M-Medium L-Low

18PCHM102	CORE II: INORGANIC CHEMISTRY I	SEMESTER – I

COURSE OBJECTIVES:

The course aims

- To study the basic idea about the structure and bonding
- To analyze the analytical tools are used in nuclear chemistry
- To understand the properties of solids
- Cognize the basics of solid state chemistry
- Evaluate the basics of magnetism and its properties

Credits: 5 **Total hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Structure and Bonding:** Hard and Soft acids and bases - classifications, Acid-Base strength, symbiosis, Theoretical basis of Hardness and Softness, applications of HSAB. Rings- Phosphazenes- Structure, Craig and Peddockmodel, Dewar model. Polysulphur - nitrogen compounds.Silicates - structure. Polyacids - Isopolyacids of V, Cr, Mo and W; Hetero polyacids of Mo and W (only structural aspects).	10	CO1
II	**Nuclear Chemistry - I:** Nuclear properties - Nuclear spin and moments, features of the liquid drop and the shell models of the nucleus; Modes of radioactive decay - orbital electron capture nuclear isomerism, internal conversion; Nuclear reactions - Types, reaction cross section, Q-value, threshold energy, compound nuclear theory, high energy nuclear reactions, nuclear fission and fusion reactions as energy sources, direct reactions, Stellar energy.	10	CO2
III	**Nuclear Chemistry-II:** Applications relating to Nuclear Chemistry - Neutron activation analysis, Radio pharmacology, Radiation protection and safety precautions, Isotopic dilution analysis. Radiation Chemistry - radiation dosimetry, radiolysis of water, and hydrated electron.	10	CO3
IV	**Solid - State chemistry:** Defects in solids - Point defects, line defects and surface defects; Non-stoichiometric compounds; Use of X-ray powder data in identifying inorganic crystalline solids; Details for cubic systems;	10	CO4

	Structures of NiAs, CdI_2, Perovskite, rutile, fluorite and antifluorite- zinc blende and wurtzite.		
V	**Properties of Solids:** Electrical properties of solids - Band Theory, conductors, insulators, semiconductors, superconductors, solid state electrolytes; Magnetic properties - dia,para, ferro, anti-ferroand ferrimagnetism - hysterisis; Optical properties - Solid-state lasers and Inorganic phosphors. Reactions in solid state, diffusion mechanism, formation of spinels; solid solutions, order-disorder transformations.	10	CO5

Text books:	
1	*Cotton F.A. and Wilkinson, G.* 2007. **Advanced Inorganic Chemistry**. [Sixth Edition]. Wiley Eastern Co, New Delhi.
2	*Arnikar, Harijeevan.* 2011. **Essentials of Nuclear Chemistry.** [Fourth Edition]. New age international, New Delhi.
3	*Anthony R. and West.* 1999. **Basic Solid State Chemistry**. [Second Edition]. John Wiley & sons, New York.
Reference Books:	
1	*Huheey. J.E, Keiter. R. L, Ellen. A.* and *Keiter.* 2006. **Inorganic chemistry principles of structure and reactivity.** [Fourth Edition]. Pearson Education, USA.
2	*Purcell. K. F* and *Kotz. J. C.* 1980. **Inorganic Chemistry**. W.B. Saunders Co, USA.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Acquire knowledge of atomic and periodic properties of elements
CO2	Understand the basic principles of acid-base chemistry and about solvents
CO3	Design the geometry of molecules and assess the nomenclature for compounds
CO4	Revise the basic concepts of quantum chemistry and utilize the principles of quantum chemistry
CO5	Formulate the laboratory techniques and prepare solutions for practicals

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	L
CO2	L	H	M	L	H
CO3	M	L	H	M	L
CO4	L	M	H	L	M
CO5	M	H	L	M	H

H-High M-Medium L-Low

18PCHM103	CORE III: PHYSICAL CHEMISTRY I	SEMESTER – I

COURSE OBJECTIVES:

The course aims

- To inculcate the principles of thermodynamics, quantum chemistry and group theory
- To provide knowledge about the rate and various theory of rates
- To feature the basics of quantum chemistry
- To estimate the types of representations of a molecule
- To know the different types of spectra of molecules

Credits: 4 **Total hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Thermodynamics I:** Partial molar properties - Partial molar free energy (Chemical potential) - Partial molar volume and Partial molar heat content - their significance and determination of these quantities. Gibbs-Duhem equation - Variation of chemical potential with temperature and pressure. Thermodynamics of real gases - gas mixture - definition of fugacity - variation of fugacity with temperature and pressure -thermodynamics of ideal and non-ideal binary solutions - dilute solutions. Determination of fugacity of real gases and vanderwaals gas - fugacity components in ideal solutions - Duhem-Margules equation.	10	CO1
II	**Quantum Chemistry – I:** Black body Radiation – Experimental results – Photoelectric effect – de-Broglie equation – Heisenberg uncertainty principle – Compton effect –operators and commutation relations – quantum mechanical postulates – Schrodinger equation and its solution to the problem of a particle in one and three dimensional boxes – the harmonic oscillator.	10	CO2
III	**Quantum Chemistry – II**: Schrödinger equation for the rigid rotator and Hydrogen atom – arriving solution for energy and wave function – the origin of quantum numbers and their physical significance – Probability distribution of electrons. Approximation methods – Perturbation and Variation methods – application to	10	CO3

	Hydrogen and Helium atom.		
IV	**Group Theory – I:** Symmetry elements and symmetry operations – Point groups –identification and Representation of groups – comparison of Molecular symmetry with Crystallographic symmetry – Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences – Character Table and their uses.	10	CO4
V	**Group Theory – II:** Symmetry selection rules for vibrational, Electronic and Raman Spectra – determination of representation of vibrational modes in non-linear molecules such as H_2O, CH_4,XeF_4, $SF_6$and NH_3–symmetry of Hybrid orbitals in non-linear molecule (BF_3, CH_4, XeF_4, $PCl_5$and SF_6) – Electronic spectra of formaldehyde.	10	CO5

Text Books:	
1	*Glasstone, Samuel.* 2007. **Thermodynamics for chemists**. [Third Edition]. Affiliated East West press, New Delhi.
2	*Prasad R. K.* 2014. **Quantum Chemistry**. [Fifth Edition]. New age publisher. New Delhi.
Reference Books:	
1	*Ramakrishnan, V.* and *Gopinathan, M. S.* 2014. **Group theory in chemistry**. [Second Edition]. Vishal Publications, Jalandar.
2	*Raman, K.V*. 2004. **Group theory and its application to Chemistry.** [Eleventh Edition]. Tata Mc.Grow Hill Publishing Co, New Delhi.
3	*Puri B. R., Sharma L. R.* and *Pathania M. S.* 2017. **Principles of Physical Chemistry**. [Forth Seventh Edition]. Vishal Publishing Co, Jalandhar.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain fundamental thermodynamic properties and solve problems using the properties and relationships of thermodynamic fluids.
CO2	Recall the basics of quantum mechanics to remind the difference between classical and quantum world.
CO3	Use approximate methods in solving molecular problems.
CO4	Express products of elements of a group defined by generators and relations in appropriate standard form.
CO5	Evaluate the definition of a simple group; calculate composition factors and composition series of certain groups.

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	M	H	M
CO2	L	M	H	M	L
CO3	L	H	M	L	M
CO4	M	L	M	H	L
CO5	M	H	L	M	H

H-High M-Medium L-Low

18PCHM104	CORE IV: SPECTROSCOPY	SEMESTER - I

COURSE OBJECTIVES:

The course aims

- To inculcate the basic principles of UV-Vis and IR spectroscopy techniques and its applications.
- To provide information about the various types of NMR spectroscopic techniques and factors affecting it.
- To acknowledge 2D NMR techniques and predict the spectra of simple molecules
- To estimate the mass spectroscopic techniques and its uses to study rearrangement reactions
- To identify spectra of organic compounds

Credits: 4 **Total hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**UV-VIS:** Ultraviolet – Visible spectroscopy – types of electronic transitions –chromophores and auxochromes - factors influencing positions and intensity of absorption bands – absorption spectra of dienes, polyenes and alpha, beta- unsaturated carbonyl compounds – Woodward – Fieser rules. **IR Spectroscopy**: Vibrational frequencies and factors affecting them – identification of functional groups – intra and inter molecular hydrogen bonding – finger print region – Far IR region – metal ligand stretching vibrations.	8	CO1
II	**NMR Spectroscopy:** Basic idea **-** Nuclear spin – magnetic moment of a nucleus – nuclear energy levels in the presence of magnetic field, relative populations of energy levels – macroscopic magnetization – basic principles of NMR experiments – CW and FT NMR – ^{1}H NMR – chemical shift and coupling constants – factors influencing proton chemical shifts and vicinal proton – proton coupling constants – ^{1}H NMR spectra of simple organic molecules. AX and AB spin system – spin decoupling – nuclear Overhauser effect – proton exchange.	8	CO2

III	**^{13}C NMR and Two - Dimensional NMR spectroscopy:** ^{13}C NMR – proton decoupled and off-resonance ^{13}C NMR spectra – factors affecting ^{13}C chemical shifts – ^{13}C NMR spectra of simple organic molecules – Basic principles of two–dimensional NMR spectroscopy – COSY, NOESY, HMBC and HSQC spectra and their applications.	8	CO3
IV	**Mass spectrometry:** Principles – instrumentation - measurement techniques - meta stable peak - N-rule – (EI & FAB) – presentation of spectral data – molecular ions – isotope ions – Fragmentation process - symbolism (scission only) - even and odd electron ions - scission with rearrangement - Retro Diels-Alder rearrangement – McLafferty rearrangement – Mass spectra of hydrocarbons, alcohols, phenols, aldehydes, ketones, carboxylic acids, thiols, ether and amines.	8	CO4
V	**Spectroscopic identification of organic compounds:** Problems involving the identification of organic compounds using UV, IR and NMR and mass spectrometry.	8	CO5

Text Books:	
1	*Dyer, D*. 1978. **Application of absorption spectroscopy of organic compounds**, Prentice –Hall, Englewood, Cliffs.
2	Gary M. Lampman, George S. Kriz, James R. Vyvyan, Donald L. Pavia. 2014. **Introduction to Spectroscopy**. [Fifth Edition]. Cengage Learning
3	*Kemp, W.* 2008. **Organic spectroscopy.** [Third Edition]. Macmillan Education, UK.
Reference Books:	
1	*Lambert J.B, H. F. Shurrell,* and *R. G. Cooks*. 1987. **Introduction to organic spectroscopy**, Mac Millan.
2	*Silverstein R. M* and *F. X. Webster.* 2014.**Spectrometric identification of organic compounds**. [Seventh Edition]. John Wiley.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Study the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
CO2	Apply formalisms based on molecular symmetry to predict spectroscopic properties.
CO3	Analyze and interpret spectroscopic data collected by the methods discussed in the course.
CO4	Operate common laboratory instruments used for chemical analysis and describe and understand the capabilities of instrumental methods.
CO5	Apply formalisms based on molecular symmetry to predict spectroscopic properties.

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	H	M	H
CO2	M	H	L	M	L
CO3	L	H	M	L	H
CO4	M	L	H	H	M
CO5	H	M	L	M	L

H-High M-Medium L-Low

18PCHMP101	CORE PRACTICAL I: ORGANIC PRACTICAL I	SEMESTER – I

COURSE OBJECTIVES:

The course aims

- To learn about the qualitative analyses by separation
- To learn the preparation of organic compounds by named reaction

Credits: 3 **Total hours: 50**

CONTENTS		CO
Separation of compounds		
Aromatic / Aliphatic Saturated / unsaturated Special elements N / S / X Functional groups Preparation of functional derivative (5 mixtures)		CO1
Preparation:		
1	*Beta* naphthyl methyl ether from *beta* naphthol	CO2
2	Res-acetophenone from resorcinol	
3	*para*-Nitrobenzoic acid from para nitrotoluene	
4	*meta*-Nitroaniline from *meta*-dinitrobenzene	
5	Methyl orange from sulphanilic acid	
6	Anthraquinone from anthracene	
7	Benzhydrol from benzophenone	

Reference Books:

1	*B.S. Furniss, A.J. Hannaford. P.W.G. Smith* and *Tatchell, A.R*. 2003.**Vogel's Practical Organic Chemistry**. [Fifth Edition]. ELBS & Longman, New Delhi.
2	*Raj K. Bansal.* 2008. **Laboratory manual of Organic Chemistry**. [5th Edition]. New Age International (P) Ltd, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Analyse organic compound s systematically and be able to identify their various chemical nature
CO2	Prepare organic compounds by various methods

18PCHMP102	CORE PRACTICAL II: INORGANIC PRACTICAL I	SEMESTER – I

COURSE OBJECTIVES:

The course aims

- To analyse inorganic mixture quantitatively
- To learn colorimetric estimation of metals
- To prepare the inorganic complexes

Credits: 3 **Total hours: 50**

CONTENTS		CO
Semi-micro qualitative analysis		
Semi-micro qualitative analysis of mixtures containing two common and two rare cations. The following are the rare to be included :W, Tl, Mo, Te, Se, Ce, Th, Be, Zr, V, U and Li.(5 mixtures)		CO1
Preparation:		
1	Potassium trioxalato aluminate(III) trihydrate	CO2
2	*Tris* thiourea copper (I) chloride	
3	Potassium trioxalato chromate(III) trihydrate	
4	Sodium *bis*(thiosulphato) cuprate(I)	
5	Tetra amminecopper(II)sulphate	
6	Potassium tetrachloro cuprate(II)	

Reference Books:	
1	*Svehla, G.*, Sivasankar, B., 2012. **Vogel's qualitative Inorganic analysis.** [Seventh Edition]. Pearson Education India.
2	*Ramanujam V.V.*1974. **Inorganic Semi-micro Qualitative analysis.** National Publishing Co.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Analyse an inorganic compound systematically by laboratory techniques
CO2	Synthesize inorganic compounds by various methods

18PLS101	CAREER COMPETENCY SKILLS I	SEMESTER – I

COURSE OBJECTIVES:

The course aims

- To impart knowledge on the Aptitude.
- To enhance employability skills and to develop career competency.

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Solving Simultaneous Equations Faster – Number System : HCF, LCM – Square roots and Cube roots - Averages	3	CO1
II	Problems on Numbers –Problems on Ages	3	CO2
III	Calendar – Clocks – Pipes and Cisterns	3	CO3
IV	Time and Work – Time and Distance	3	CO4
V	Ratio and Proportion – Partnership – Chain Rule	3	CO5

Text Book:

1	*Aggarwal R.S. 2013.* **Quantitative Aptitude. [Seventh Revised Edition].**S.Chand& Co., New Delhi.

Reference Book:

1	*Abhijith Guha,* **Quantitative Aptitude for Competitive Examinations**, 5th Edition, Tata McGraw Hill, 2015, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to :

CO1	Carry out mathematical calculations using shortcuts.
CO2	Calculate Problems on Ages with shortcuts.
CO3	Understand the core concepts of Pipes & Cisterns, Calendar & Clocks.
CO4	Obtain knowledge on shortcuts to Time & Work and Time & Distance.
CO5	Calculate Ratio & Proportion, Partnership with shortcuts.

18PCHM201	**CORE V: ORGANIC CHEMISTRY II**	**SEMESTER – II**

COURSE OBJECTIVES:

The course aims

- To provide knowledge about the isolation, and elucidation of various natural products
- To know different chemical reactions in heterocyclic compounds
- To identify the mechanism of elimination and addition reactions
- To analyze the function of nucleic acids and chemistry behind the proteins
- To recognize the structure and synthesis of alkaloids and terpenoids

Credits: 5 **Total hours: 50**

UNIT	CONTENTS	Hrs.	CO
I	**Aliphatic Nucleophilic Substitution Reaction:** The SN_2, SN_1 and SN_i, SN'_1, SN'_2 mechanisms, Effects of substrates, attacking nucleophile, leaving group. Neighboring group participation by π and σ bonds, anchimeric assistance. Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon. Williamson reaction, Vonbraun reaction. Aromatic nucleophilic substitution reactions, SNAr mechanism, aryl cation mechanism, Benzyne mechanism, aromatic nucleophilic substitution of activated halides – Ziegler alkylation, Chichibabin reaction.	10	CO1
II	**Heterocyclic Compounds:** Synthesis and properties of imidazole, oxazole and thiazole. Synthesis, properties and structural elucidation of flavones, isoflavones and anthocyanins. Synthesis of pyrimidines, synthesis and structural elucidation of purines (uric acid and caffeine).	10	CO2
III	**Elimination Reactions and Addition Reactions:** E_1, E_2, E_1cB and E_2CB mechanisms; Stereochemistry of elimination – Hofmann and Saitsev rules; Competition between elimination and substitution; pyrolytic *cis* elimination – Chugaev reaction; Bredt's rule; Hofmann degradation and Cope elimination. Electrophilic, Nucleophilic and Free radical additions – Additions of halogen and halogen acids to C–C multiple bonds; Markovnikov and Anti Markovnikov addition; Stereochemistry of additions;	10	CO3

	Hydroboration and Diels – Alder reactions. Reactions of carbonyl group – Mechanisms of Aldol, Perkin, Stobbe and Dieckmann condensations.		
IV	**Peptides, Proteins and Nucleic Acids**: Basic idea about peptides - classification of proteins, Sequence analysis of peptides by chemical, enzymatic and mass spectrometric methods; Peptidisation methods like activated ester method, mixed anhydride method using reagents like DCC and Woodward reagent. Primary, secondary and tertiary structures of proteins and their functions. Nucleic acids – nucleosides,nucleotides and their chemistry including synthesis, RNA and DNA; Functions of nucleic acids.	10	CO4
V	**Alkaloids and Terpenoids:** General methods of structural elucidation of alkaloids; Structure, synthesis and stereochemistry of Quinine, papaverin, lysergic acid, atropine and reserpine; Biosynthesis of alkaloids. Structure, Stereochemistry and synthesis of zingiberene, cadinene and abietic acid; Biosynthesis of terpenoids.	10	CO5

Text Books:

1	*Mukherji, S .M.* and *Singh, S.P.* 2009. **Reaction Mechanism in Organic Chemistry**. [Fifth Edition-reprint]. Macmillan Publishers, London.
2	*Morrison boyd & Bhattacharjee.* 2010. **Organic Chemistry**. [Seventh Edition]. Prentice-Hall, New Delhi.
3	*Kalsi. P.S.* 2010. **Organic Reactions and Mechanisms**. [Third Edition]. New Age International Publishers, New Delhi.

Reference Books:

1	*Jerry March.* 2013. **Advanced Organic Chemistry-Reactions, Mechanisms and Structure.** [Seventh Edition]. John Wiley &Sons, New York.
2	*Francis A. Carey.* 2015. **Organic Chemistry.**[Tenth Edition]. The McGraw-Hill Companies, New York.
3	*Kalsi, P.S.* 2005. **Stereochemistry – Conformation and Mechanism**. [Sixth Edition]. Wiley Eastern Limited, New Delhi.
4	*Finar, I.L.* 2000. **Organic Chemistry**, Volume II, [Fifth Edition]. First Indian reprint, Pearson Education Asia Pvt. Ltd., USA.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recognize, and predict the reaction outcome for, common transformations of alkenes, alkynes and aromatic compounds with mechanism
CO2	Recall the methodologies of synthesis of heterocyclic compounds
CO3	Apply the concepts of acidity and basicity in daily life
CO4	Evaluate the concepts and basic ideas of protein & nucleic acids and their functions
CO5	Understand the basic chemical and structural features of alkaloids and terpenoids

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	L	H	L
CO2	H	M	M	H	H
CO3	M	L	H	M	L
CO4	L	H	M	L	M
CO5	L	H	L	M	H

H-High M-Medium L-Low

18PCHM202	CORE VI: INORGANIC CHEMISTRY II	SEMESTER - II

COURSE OBJECTIVES:

The course aims

- To know basic idea on stability and reaction mechanism of coordination complexes
- To learn about organometallic compounds and catalysis
- To evaluate the stability and stereochemical aspects of inorganic complexes
- To recognize the reaction mechanism of coordination complexes
- To gain knowledge about the vitality of catalysts in organometallic reaction

Credits: 5 **Total hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Metal - Ligand Bonding**: Crystal field theory - splitting of d-orbitals under various geometries, factors affecting splitting, CFSE, evidences for CFSE (Structural and thermodynamic effects), Spectrochemical series; Jahn-Teller distortion - Splitting pattern in octahedral complexes, Dynamic and Static J. T. effect, Jahn-Teller effect and Chelation; Limitations of CFT; Evidences for metal-ligand overlap; M.O. theory and energy level diagrams, concept of weak and strong fields, sigma and pi bonding in complexes, nephelauxetic effect and magnetic properties of complexes.	10	CO1
II	**Stability and Stereochemical aspects of complexes**: Stability of complexes - Factors affecting stability of complexes, thermodynamic aspects of complex formation, Stepwise and overall formation constants, stability correlations, statistical and chelate effects; Determination of stability constant - Polarographic, photometric and potentiometric methods. Stereochemical aspects - Stereoisomerism in inorganic complexes, isomerism arising out of ligand distribution and ligand conformation, chirality and nomenclature of chiral complexes; application of ORD and CD in the identification of chirality of complexes.	10	CO2

III	**Reaction mechanisms in Complexes**: Electron transfer reactions - Outer and inner sphere processes; Cross reactions and Marcus-Hush theory. Reaction mechanism of coordination compounds, Labile and inert complexes. General mechanism of Substitution in square planar and octahedral complexes - Trans effect -Replacement of coordinated water - mechanism of acid hydrolysis and base hydrolysis - Conjugate base mechanism - Application of substitution reaction in the synthesis of Platinum and cobalt complexes.	10	CO3
IV	**Organometallics:** Basic concepts –Hapticity, ligand classification, synthesis and structure – 18 electron rule – applications and limitations – isolable concept and its usefulness. Preparation, properties, structure and bonding in metal carbonyls, nitrosyls, metal olefins, acetylenes, metallocene and arene complexes.	10	CO4
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 of olefins (Wilkinson's catalyst), hydroformylation of olefins using Cobalt or Rhodium catalysts (oxo process), Oxidation of olefins to aldehydes and ketones (Wacker process), Zeigler-Natta catalyst and carbonylation of methanol.	10	CO5

Text Books:	
1	*Banerjea, D.* 2009. **Coordination Chemistry**. [Third Edition]. Tata McGraw Hill. New York.
2	*Huheey. J.E, Keiter. R. L, Ellen. A* and *Keiter*. 2006. **Inorganic chemistry principles of structure and reactivity.** [Fourth Edition]. Pearson Education, USA.
3	*Madan R.D.,Tuli G.D.* and *Malick S.* 2010. **Selected Topics in Inorganic Chemistry**, [Revised edition] S.Chand& Co., New Delhi.
4	*Gopalan F.A*. and *Ramalingam V*. 2001. Concise Coordination Chemistry, Vikas Publisher, New Delhi.
Reference Books:	
1	*Shriver D. F, Atkins P.W.* and *Langford C.H*. 2010. **Inorganic chemistry.** [Fifth Edition].
2	*Cotton, F. A*. and *Wilkinson, G.* 2000. **Advanced Inorganic Chemistry**. [Sixth Edition].Wiley Eastern, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Rationalize the synthesis, structure, bonding, properties and reactivity of both main group and transition metals
CO2	Predict the stereochemical outcome of reactions in organometallic compounds by considering the reaction mechanism
CO3	Predict the mechanisms taking place in square planar and octahedral complexes using various theories
CO4	Recognize structure and bonding issues to understand the stability and reactivity of simple organometallic complexes
CO5	Know the important applications of organometallic homogeneous catalysis in its production

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	H	M
CO2	M	L	H	M	L
CO3	M	H	M	L	L
CO4	H	L	H	M	M
CO5	L	M	L	H	H

H-High M-Medium L-Low

18PCHM203	CORE VII: PHYSICAL CHEMISTRY II	SEMESTER – II

COURSE OBJECTIVES:

The course aims

- To gain the knowledge about statistical thermodynamics, chemical kinetics and electrochemistry
- To understand the basic principles of chemical kinetics
- To provide knowledge about reactions in solutions
- To cognize electrochemical theories and their phenomena
- To inculcate the concepts of spectroscopy quantum mechanically

Credits: 4 **Total hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Thermodynamics - II**: Derivation of Boltzmann distribution equation – physical significance of partition function- translational, rotational, vibrational and electronic partition functions – Quantum statistics – Bose – Einstein and Fermi – Dirac distribution equations – comparison of B.E and F.D statistics with Boltzman statistics – Concept of Negative Kelvin Temperature. Partition function- Relationships between partition function and thermodynamic properties such as E, H, Cp, Cv, P. Derivation of PV=RT. Calculation of S, A, G etc., from partition functions– calculation of equilibrium constants for very simple reactions.	8	CO1
II	**Chemical Kinetics – I:** Theories of Reaction rates – Arrhenius theory – effect of temperature on reaction rate – Hard – Sphere collision theory of reaction rates –molecular beams – Reaction cross section – effectiveness of collisions – Probability factor. Transition state theory of reaction rates – Potential energy surfaces – Partition functions and activated complex – Eyring equation – Comparison of collision theory and activated complex theory – Estimation of free energy, enthalpy and entropy of activation and their significance.	8	CO2

III	**Chemical Kinetics – II**: Reactions in solutions – comparison between gas phase and solution reactions – Diffusion controlled reaction - the influence of solvent, ionic strength, dielectric constant and pressure on rate of reactions in solution – Kinetic isotope effects – primary and secondary effects - Linear free energy relationship – Hammett and Taft equations.	8	CO3
IV	**Electrochemistry - I**: Ions in solutions – Debye – Huckel theory of strong electrolytes – Debye – Huckel – Onsager equation – verification and limitation – Debye – Huckel limiting law and its extension. Electrode – Electrolyte interface - adsorption at electrified interface – electrical double layers – Electro capillary phenomena – Lippmann capillary equation – structure of double layers – Helmholtz-Perrin, Gouy-Chapman and Stern models of electrical double layers – electro kinetic Phenomena – Tiselius method of separation of proteins –Membrane potential.	8	CO4
V	**Molecular Spectroscopy – I:** Interaction of matter with radiation – Einstein's theory of transition probability – Rotation spectroscopy – Rigid Rotor – Intensity of spectral lines – Molecular parameters from rotation spectra - Effect of isotopic substitution on the rotation spectra Vibrational spectroscopy – harmonic oscillator – anharmonic oscillator – Hot bands – selection rules – Vibrational spectra of polyatomic molecules – Overtones and combination frequencies – Fermi Resonance. Raman spectroscopy – Raman effect –Rotational and vibrational - Raman Spectra – Mutual Exclusion Rule.	8	CO5

Text Books:	
1	*Rajaram, J* and *Kuriacose J.C.* 2011. **Kinetics and mechanism of chemical transformation.** Macmillan India Ltd, New Delhi.
2	*Glasstone, Samuel.* 2007. **Thermodynamics for chemists**. [Third Edition]. Affiliated East West press, New Delhi.
3	*Prasad R. K.* 2014. **Quantum Chemistry**. [Fifth Edition]. New age publisher. New Delhi.
4	*Gurudeepraj*.2014.**Advanced Physical Chemistry**. Goel Publishing House, Meerut.
5	*Puri P. R., Sharma L. R.* and *Pathania M. S.* 2010. **Principles of Physical Chemistry**, Vishal Publishing Co, Jalandhar.
Reference Books:	
1	*Harris, G.M.1966*. **Chemical Kinetics**. D.C. Heath &Co, USA.
2	*Moore W.J.*1998. **Physical Chemistry**, [Fifth edition]Orient Longman, London.
3	*Banwell C.* 1995. **Fundamentals of Molecular Spectroscopy**, [Fourth edition-reprint]McGraw Hill, New York.
4	*Laidlar, K.J.*2008. **Chemical Kinetics**. [Third edition-reprint] Harper and Row, New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Discuss, develop and apply various quantum mechanical equations for open and closed systems.
CO2	Describe how the collision frequency, kinetic energy and orientation of colliding reactant molecules affect the rate of a chemical reaction.
CO3	Demonstrate the coefficients of a balanced chemical equation to express the rate of reaction.
CO4	Recall the concepts of electrochemistry and about electric double layer models.
CO5	Understand the principles and the important effects in molecular spectroscopy.

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	M	H	L
CO2	L	M	H	M	L
CO3	L	H	M	L	M
CO4	M	L	H	M	L
CO5	H	H	L	M	L

H-High M-Medium L-Low

18PCHEL201	ELECTIVE I:POLYMER CHEMISTRY I	SEMESTER - II

COURSE OBJECTIVE:

The course aims

- To know the basic concepts of polymer, coordination in polymer, properties of commercial polymers and polymer processing
- To gain knowledge about Coordination polymerization and the catalysts that enhances
- To recognize the properties of polymer and its measurements
- To understand the processing of polymers and its types
- To provide the knowledgeabout properties and chemistry behind commercial polymers

Credits: 4 **Total hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Basic Concepts**: Monomers, functionality of monomers and polymers, degree of polymerization, Linear, branched and network Polymers. Condensation Polymerization: Mechanism of stepwise polymerization. Kinetics and statistics of linear stepwise polymerization. Addition polymerization: Free radical, cationic and anionic polymerization. Polymerization conditions. Polymerization in homogeneous and heterogeneous systems.	8	CO1
II	**Co-ordination Polymerization: Z**eigler-natta catalyst-kinetics, mono and bi metallic mechanism of co-ordination polymers. Co-polymerization: Block and graft co-polymers, kinetics of co polymerization. Types of co-polymerization. Evaluation of monomer. Monomer Reactivity ratio. Rate of co-polymerization.	8	CO2
III	**Molecular Weight and Properties**: Poly dispersion – average molecular weight concept, number, weight and viscosity average molecular weights. Measurement of molecular weights - Gel permeation chromatography and light scattering. Polymer structure and physical properties – crystalline melting point T_m.The glass transition temperature. Factors affecting T_g and T_m.	8	CO3

IV	**Polymer Processing:** Plastics, elastomers, resins and fibres. Compounding processing technique, calendaring, die-casting, rotational casting, film casting, injection moulding, blow moulding extrusion, moulding, thermo forming, foaming, reinforcing and fibre spinning.	8	CO4
V	**Properties of Commercial Polymers**: Polyethylene, polyvinylchloride, polyamides, polyesters, polyurethane, polycarbonate, phenolic resins, epoxy resins. Contact lens, dental polymers, artificial heart, volve, kidney, skin and blood cells.	8	CO5

Text Books:	
1	*Billmeyer, F.W.* 2003. **Text Book of Polymer Science**. [Third Edition]. John Wiley &Sons, New York.
2	*Gowariker, V.R. Viswanathan, N.V* and *Sreedha J.* 2015. **Polymer Science**. [Second Edition]. New Age International Ltd, New Delhi.
Reference Books:	
1	*Allcock, H. R* and *Lamber, F.W. 2004*. **Contemporary Polymer Chemistry.** [Third Edition]**.** Prentice Hall, New Delhi.
2	*Flory, P. J.* 1995. **Principles of Polymer Chemistry**. [First edition-16th reprint].Cornell University press, New York.
3	*Odian, G. 2007.* **Principles of Polymerization**. [Fourth Edition]. John Wiley & Sons, New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the basic concepts and types of polymers
CO2	Understand the role of catalyst and techniques of polymerization
CO3	Know about the properties and measurement of molecular weights
CO4	Estimate the processing techniques of polymer
CO5	Demonstrate the properties of commercial polymers

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	M	H	L
CO2	H	M	H	M	L
CO3	L	H	M	L	M
CO4	M	L	H	H	L
CO5	M	H	L	M	H

H-High M-Medium L-Low

18PCHEL202	ELECTIVE I:BIO-INORGANIC CHEMISTRY I	SEMESTER - II

COURSE OBJECTIVE:

The course aims

- To understand the role of various elements in the living systems.
- To acquire basic knowledge about the structure and functions of certain metallo-enzymes.
- To get an insight on the use of several spectroscopic and analytical techniques for structural investigation of bioinorganic compounds.
- To know about the mechanism of binding interactions of metal complexes with biomolecules and metal based drug action.

Credits: 4 **Total hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Metals and Non-metals in biological systems**-Essential and trace elements - Role of different metal ions in biological systems – Sodium – Potassium pump - Phorphyrin system - Structure and functions of Hemoglobin and Myoglobin -Dioxygen binding, transport and utilization-Structure and functions of Chlorophyll.	8	CO1
II	**Metallo enzymes** - Definition - Examples –Structure and functions of - Carboxy peptidase-A and Carbonic anhydrase - Superoxide dismutase (SOD) - Xanthine oxidase – Nitrogenase - VitaminB_{12} co-enzyme- Non-Hemeiron – sulphur proteins – Ferridoxins - Rubredoxins - Cytochrome *C* - Blue copper proteins- Plastocyanin.	8	CO2
III	**Applications of physical methods to bioinorganic chemistry:** (Exclusive of Instrumentation) - X-ray absorption spectroscopy (XAS) and Extended X-ray absorption fine structure (EXAFS) -Nuclear magnetic resonance spectroscopy(NMR) and Electron paramagnetic resonance method (EPR)-Mossbauer spectroscopy-Circular dichroism (CD) – Electronic spectroscopy(UV-visible and fluorescence emission)	8	CO3
IV	**Binding of metal ions and complexes to biomolecules:**	8	CO4

	Types of binding – Nucleic acid structures - Fundamental interactions with nucleic acids – Binding interactions of tris-phenanthroline metal complexes with DNA-Techniques to monitor binding. Chemotherapy-Radio diagnostic agents- MRI scanning – Chelating Agents (with special reference to EDTA) and therapy based on *in vivo* chelation of radio nucleotides-Dosage and toxicity.		
V	**Drug discovery and design** – Therapeutic index and chemotherapeutic index - Structure- activity relationship-Factors governing drug design – Computer aided drug design - Cancer chemotherapy - Bioinorganic chemistry of platinum and ruthenium anticancer drugs – Mechanism of action of cis-platin - Clinical trials and their significance - Applications of Coordination complexes in medicine and agriculture	8	CO5

Text Books:	
1	*Artherden, L.M.Bentley* and *Driver's*, 2003. **Textbook of Pharmaceutical Chemistry**, [Eighth edition]. Oxford University Press, New Delhi. 2003.
2	*Block, J.H.Roche, Soine, E.T.O*. and *Wilson, C.O*. 1986. **Inorganic Medicinal & Pharmaceutical Chemistry,** [First edition], Varghese publishing house, Mumbai.
3	*Rao, K.S*. and *Suresh, C.V*. 2011. **Pharmaceutical Inorganic Chemistry**, Pharma Med Press.
4	*Kasture, A.V. Wadodkar, S.G.* 2008. **Pharmaceutical Chemistry-I**, [Twenty Fifth edition]. Nirali Prkashan.
5	*Rajasekaran, V. N.* 2005. **Text Book of Pharmaceutical Inorganic Chemistry Theory and Practical**, [Second edition]. Sun Publication, Chennai.
Reference Books:	
1	I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, 1994.**Bioinorganic Chemistry**, University Science Books.

2	Dr Asim K Dass, 2015. **Bioinorganic Chemistry**, Books and Allied (P)Limited.
3	Lawrence Que,Jr, 2000. **Physical Methods in Bioinorganic Chemistry-Spectroscopy and Magnetism**, University Science books.
4	J.E. Huheey, E.A. Kieter, R.L. Keiter, 1997. **Inorganic Chemistry** [Fourth Edition], Addision Wesely Publishing Company.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the essential and trace elements in biological systems
CO2	Estimate the topical agents and its role in biological system
CO3	Demonstrate the chemical compounds as gastro intestinal agents
CO4	Predict the role of chemical compounds as electrolytes
CO5	Assess the utilization of inorganic Radio-Pharmaceuticals

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	L	M
CO2	M	L	H	M	H
CO3	H	H	M	L	L
CO4	L	M	L	H	M
CO5	M	L	M	M	H

H-High M-Medium L-Low

18PCHEL203	**ELECTIVE I:PRINCIPLES AND APPLICATIONS OF DRUG DESIGN AND DISCOVERY**	**SEMESTER - II**

COURSE OBJECTIVES:

The course aims

- To enable students to identify compounds in biological system
- To describe the various drug – receptor interactions
- To provide information the drug molecules and its chemistry
- To enumerate steps to synthesize a drug molecule by various methods
- To know about drug Identification and Validation Steps in drug discovery

Credits: 4 **Total hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Drug Design and Discovery:** Historical background - drug targets: lipids, carbohydrates, proteins, enzymes, and nucleic acids as drug targets and receptors. Receptor Pharmocology – Agonists and Antagonists (partial and full) - Allosteric Modulators – Pharmacokinetics and pharmacodynamics: administration, absorption, distribution, metabolism, elimination of drugs - bioavailability of drugs - side effects - Case study: serotonin and dopamine receptors and transferring drugs.	8	CO1
II	**Drug Identification and Validation Steps in drug discovery:** Leads identification – Hits - Drug validation - Natural products as drugs – molecular recognition in drug design – thermodynamic considerations – physical basis and inter molecular interactions between drugs and targets like electrostatic interactions – ionic bonds - hydrogen bonds – Inductive interactions – dispersive forces. Stereochemistry in drug designing – stereospecificity of drug targets – Eudesmic ratio – Examples of Eutomers and Distomers.	8	CO2
III	**Retrosynthetic strategies for Drug Synthesis:** Introduction to retrosynthetic analysis and disconnection approach – synthons acceptor and donor – synthetic equivalents- umpolungs – planning a synthesis – relay and convergent routes - Guidelines for disconnection – one group C-X and	8	CO3

	C-C disconnections – Chemoselectivity. Two group C-C disconnections in dicarbonyls – Case Study: Synthesis of Amelfolide.		
IV	**Computer Aided Drug Design:** Molecular modeling in drug design – Energy Minimization methods – both Molecular Mechanics and Quantum mechanical Methods – Energy minimization – Conformational analysis –Structure based and Ligand based Drug design – QSAR – parameters – Quantitative models of QSAR – Hansch methods – free Wilson model - 3D pharmacophore modeling – Docking – rigid and flexible methods of docking – Prediction of Binding modes – Protein Ligand binding free energies - Docking Score – validation.	8	CO4
V	**Quantum Mechanical Methods:** Electronic structure calculations – Geometry Optimization – Potential Energy Surface – Global and Local Minima – Identification of Transition states – Semiemperical and Density Functional Methods - Calculation of atomic Charges, Electrostatic Potential Maps.	8	CO5

Text Books:

1	Andrew, *R.Leach, Valerie J Gillet*, 2007. **An Introduction to Cheminformatics**, Revised Edition, Springer, Netherland.

Reference Books:

1	*Larsen* et al, 2004. **Text book of Drug design and Discovery**, [Fourth Edition]. London and New york, Taylor and Francis.
2	*Graham L. Patrick*, 2009. **An Introduction to Medicinal Chemistry**, [Fourth Edition]. Oxford University Press.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Know the concepts of drug design and discovery
CO2	Assess the prediction of drug identification and validation steps in drug discovery
CO3	Recall the retrosynthetic strategies for drug synthesis
CO4	Predict the processes in computer aided drug design
CO5	Cognize the quantum mechanical methods in principles and applications of drug design and discovery

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	M	M	L
CO2	H	M	L	H	H
CO3	M	L	H	L	M
CO4	L	M	H	L	M
CO5	L	H	L	M	H

H-High M-Medium L-Low

18PCHMP201	**CORE PRACTICAL III : ORGANIC PRACTICAL II**	**SEMESTER - II**

COURSE OBJECTIVES:

The course aims

- To have practical skill on estimation and preparation of organic compounds
- To know the techniques of extraction from natural products

Credits: 3 **Total hours: 50**

	CONTENTS	**CO**
Organic Estimation		
	Phenol	CO1
	Aniline	
	Glucose	
	Iodine value of an oil	
	Saponification value of an oil.	
Organic Preparation		
1	*Sym*-tribromobenzene from aniline.	CO2
2	*m*-Nitrobenzoicacid from methyl benzoate.	
3	*para*–Nitroaniline from acetanilide.	
4	Benzanilide from benzophenone.	
5	*para*-Aminobenzenesulphonamide from acetanilide	
Organic Extraction		
1	Caffeine from tea leaves.	CO2
2	Citric acid from lemon.	

Reference Books:	
1	*B.S. Furniss, A.J. Hannaford. P.W.G. Smith* and *Tatchell, A.R*. 2003.**Vogel's Practical Organic Chemistry**. [Fifth Edition]. ELBS & Longman, New Delhi.
2	*Raj K. Bansal.* 2008. **Laboratory manual of Organic Chemistry**. [Fifth Edition]. New Age International (P) Ltd, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Able to estimate an organic compound
CO2	Capable to synthesize and extract various organic compounds

18PCHMP202	CORE PRACTICAL IV:PHYSICAL PRACTICAL I	SEMESTER - II

COURSE OBJECTIVES:

The course aims

- Students have a practical skill on Experiments in chemical kinetics, phase rule, Chemical equilibrium
- To study the kinetics reactions practically
- To practically conduct Conductivity measurements by different types of chemicals

Credits: 3 **Total Hours : 40**

EXPT NO.	CONTENTS	CO
Titrimetric Quantitative Analysis		
1	Study the kinetics of acid hydrolysis of an ester.	CO1
2	Molecular weight determination by Rast method.	CO1
3	Determination of association factor of benzoic acid in benzene by distribution method	CO1
4	Conductometric titrations of a mixture of acidsagainst Sodium hydroxide.	CO1
5	Conductometric titrations of a weakacidagainst Sodium hydroxide.	CO1
6	Determination of equivalent conductivity of a strong electrolyte at different concentrations.	CO1
7	Determination of the equilibrium constant of the reaction between KI & $K_2S_2O_8$.	CO2
8	Study the phase diagram form- toluidine and glycerine system.	CO2
9	Construction of phase diagram for a simple binary system(naphthalene –Phenanthrene and benzophenone – diphenylamine)	CO2
10	Construction of the phase diagram of the three components of partially immiscible liquid systems (DMSO – Water – Benzene; Water-Benzene – Acetic acid; Ethyl alcohol–Benzene–Water; Acetone-Chloroform–Water; Chloroform – Acetic acid-Water).	CO2

Reference Books:	
1	*Venkateswaran V.* and *Kulandaivelu* A.R. 2012. **Basic Principles of Practical Chemistry.** [Second Edition]. Sultan Chand & Sons, New Delhi.
2	*Bassett J.et al.,* 1989. **Vogel's Textbook of Quantitative Inorganic Analysis.** [Fifth Edition]. ELBS Longman, New york.
3	*Bajpai D.N., Pandey O.P.* and *Giri S.* 2012. B.Sc., **Practical Chemistry**, Revised Edition. S. Chand & company, New Delhi.
4	*J.P. Singh* and *G.R. Verma.* 1999. **Practical Chemistry Vol. I & II,** Revised Edition. S. Chand & company, New Delhi.
5	*Thomas. A.O.* 2000. **Practical Chemistry**. [Sixth Edition]. Sharada Press, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recognize various physical techniques and principles of kinetics
CO2	Estimate the conductometric titrations using different chemicals at various concentrations

18PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER - II

COURSE OBJECTIVES:

The Course aims

- To make the students to understand the concepts of human rights.

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	**Human Rights:** Definition - Historical Evolution - Classification of Rights - Universal Declaration of Human Rights - International Covenants on Economic and Social Rights - Constitutional Provision for Human Rights - Fundamental Rights - Directive Principles of the State Policy - Indian Constitution.	5	CO1
II	**Civil and Political Rights:** Right to Work - Right to Personal Freedom - Right to Freedom of Expression - Right to Property - Right to Education - Right to Equality-Right to Religion - Right to Form Associations and Unions - Right to Movement-Right to Family - Right to Contract - Right to Constitutional Remedies-Right to Vote and Contest in Elections - Right to Hold Public Offices-Right to Petition-Right to Information - Right to Criticise the Government-Right to Democratic Governance.	5	CO2
III	**Economic Rights:** Right to Work - Right to Adequate Wages - Right to Reasonable Hours of Work - Right to Fair Working Conditions - Right to Self Government in Industry - Customer Rights - Social and Cultural Rights - Right to Life - Right to Clean Environment.	5	CO3
IV	**Women's Rights:** Right to Inheritance - Right to Marriage - Divorce and Remarry -Right to Adoption - Right to Education - Right to Employment and Career. Advancement - Rights Relating to Dowry - Right for Equality - Right for Safe Working Conditions - Children's Rights - Right to Protection and Care – Right to Education - Issues Related with Infanticide - Street Children – Child Labour-Bonded Labour - Refugees Rights - Minority Rights - Dalit Rights-Tribal Rights-Nomads Rights.	5	CO4

V	**Human Rights Violation:** International, National, Regional Level Organizations to Protect Human Rights - UNO - National Commission for Human Rights - State Commissions - Non Governmental Organizations and Human Rights - Amnesty Terrorism and Human Rights - Emergency and Human Rights - Judiciary and Human Rights - Media and Human Rights - Police and Human Rights.	**CO4**	**CO5**

Reference Books:

1	*Paul Singh.* **Human Rights and Legal System.** Himalaya Publishing House, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand the core principles of human rights philosophy
CO2	Know the importance and functions of human rights commission
CO3	Apply their rights for democracy, human rights and gender equality
CO4	Know the rights from the Governance, economic and social development through various Acts
CO5	Understand the right to information Act, rights for women, children, Nomads, refugees and various sector of people in our country

18PLS201	CAREER COMPETENCY SKILLS II	SEMESTER – II

COURSE OBJECTIVES:

The course aims

- To enhance employability skills and to develop career competency.

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Interview Skills – Types of Interview – Groundwork before Interview – Abide by the dress code – Importance of Body language in Interviews – Tell Us about yourself – Do's and Don'ts of an interview – Concluding an Interview – A Mock Interview.	3	CO1
II	Resume Preparation – Difference between a Resume and CV – The main body of Resume – The Career objective in Resume – A Fresher's Resume – Antiquity of Soft Skills – Classification of Soft Skills – Personality Analysis – Interpersonal Skills.	3	CO2
III	Body Language – Emotion displayed by Body Language – Group Discussion – Group Discussion types – Guidelines Do's and Don'ts during a Group Discussion – Concluding the Discussion – The technique of Summing Up.	3	CO3
IV	Speaking Skills – Effective Speaking Guidelines – Reading Skills – Types of Reading Skills – Barriers to Speed Reading – Listening Skills – Stages of Listening – Types of Listening – Barriers to Listening – Beware of Pitfalls – Avoid Errors : Indianisms in English – Most common errors in the world – Similar but not Quite the same – Words that are Singular or Couple.	3	CO4
V	Avoid Pitfalls: of Beware Self-improvement - Facilitating Laboratory: Language Techniques and Concepts E-learning	3	CO5

Reference Book:	
1	*S.P.Dhanavel. 2015,* **English and Soft Skills**. [Second Edition]. Orient Black Swan Publishers, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to :

CO1	Understand the types of Interviews, Dress Code and Styles
CO2	Develop Resume content and structures.
CO3	Improve body language skills.
CO4	Know how to represent self through communication.
CO5	Attain the different level of Learning Skills.

18PCHM301	CORE VIII: ORGANIC CHEMISTRY III	SEMESTER - III

COURSE OBJECTIVES:

The course aims

- To know about reactions like Oxidation, reduction and Pericyclic reactions
- To study about reagents used in organic synthesis, and conformational analysis of simple and substituted compounds, structure and stereochemistry of steroids.
- To know the chemistry of steroids in biological systems
- To acquire knowledge about oxidation reduction reactions in various organic compounds
- To study about pericyclic reactions in organic compounds

Credits: 5 **Total hours: 60**

UNIT	CONTENTS	Hrs	CO
I	**Reagents in Organic Synthesis:** Synthesis of organic molecules using acylation, alkylation of enamines and active methylene compounds. Robinson annulation, protection and deprotection of functional groups (R-OH, R-CHO, RCOR,R- NH_2 and R-COOH) Reagents and their synthetic uses: DCC, trimethylsilyl iodide, trimethylsilyl chloride, 1,3– dithiane (umpolung), di isobutyl aluminium hydride (DIBAL), 9BBN,Osmium tetroxide, DDQ, Selenium dioxide, Phase transfer Catalysts.	12	CO1
II	**Conformational Analysis:** Conformational analysis of cyclohexanes and acyclic (n-butane) systems, conformation of simple 1,2 disubstituted derivatives–ethylene chlorohydrin and ethylene glycol, Conformational analysis and stereochemical features of disubstitutedcyclohexane's (1,2 ; 1,3 ; 1,4 dialkylcyclo hexanes),conformation and stereochemistry of cis and trans decalins, effects of conformation on reactivity in acyclic and cyclohexane's, Oxidation and acylation of cyclohexanols, reduction of cyclohexanones, esterification and hydrolysis of cyclohexane carboxylic acid derivatives.	12	CO2
III	**Steroids** Structure and Stereochemistry of Cholesterol. Conformation of OH, double bond in Cholesterol. Reactions of Oestrone, Conversion of cholesterol into progesterone, testosterone and oestrone. Artificial	12	CO3

	hormones–Stilboestrol and Hexoestrol.		
IV	**Oxidation and Reduction Reactions:** Oxidation of alcohols by CrO_3, DMSO and DMSO in combination with DCC; acetic anhydride and oxalyl chloride. Oxidation of arylmethane -oxidation of alpha methylene to carbonyl. Allylic oxidation of olefins, oxidative cleavage of glycols, oxidative cleavage of double bonds by ozonolysis. Reduction of carbonyl compounds by hydrides, selectivity in reduction of 4– ter – butyl cyclohexanone using selectrides. **Reduction:** Clemmensen- Wolff Kishner, Birch, MPV.	12	CO4
V	**Pericyclic Reactions:** Pericyclic reactions, classification, orbital symmetry, Woodward Hofmann rules, selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts, analysis by correlaton diagram method and Frontier molecular orbital method, Sommelet, Hauser, Cope and Claisen rearrangements. Perturbation Molecular Orbital theory	12	CO5

Text Books:

1	*Jerry March*. 1992. **Advanced Organic Chemistry- Reactions, Mechanisms and Structure**, [Fourth edition], John Wiley &Sons, New York.
2	*Kalsi, P.S.*2002. **Organic Reactions and Mechanisms**. [Second Edition]. New Age International Publishers, New Delhi.
3	*Finar*, *I.L.* 2000. **Organic Chemistry -** Volume II. [5th Edition]. First Indian reprint. Pearson Education Ltd, London.
4	*Chatwal*, *G.* 2014. **Organic Chemistry of Natural Products** - Vol I&II. Himalaya Publishing House, Mumbai.
5	*Mukherji, S .M.* and *Singh, S.P.* 2009. **Reaction Mechanism in Organic Chemistry**. [Fifth Edition-reprint]. Macmillan Publishers, London.

6	*Jagadamba Singh, L. D. S Yadav* **Organic Synthesis,** Pragati edition.
Reference Books:	
1	*Francis A.Carey*. 1996. **Organic Chemistry**. [Third Edition]. The McGraw Hill Companies, Inc, New York.
2	*Morrison, R.T.* and *Boyd, R.N.1992***. Organic Chemistry**. [Sixth Edition]. Prenticemn Hall, New Delhi.
3	*Agarwal, O.P. 1988*. **Chemistry of Organic Natural Products**. Vol I &II. Goel Publishing House, Meerut.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the fundamental principles of organic chemistry that include chemical bonding, structural isomerism, stereochemistry, chemical reactions and mechanism.
CO2	Develop basic skills for the multi-step synthesis of organic compounds and justify a reasonable mechanism for a chemical reaction.
CO3	Recognize the structure and function of vitamins, antibiotics, penicillin, streptomycin, chloromycetin, etc.,
CO4	Interpret the concept of aromaticity and the main properties of aromatic compounds and evaluate stereochemistry in organic compounds.
CO5	Evaluate the concept of rearrangement reactions in organic compounds.

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	H	H	L
CO2	L	H	L	M	H
CO3	M	L	H	L	M
CO4	H	M	M	H	L
CO5	L	H	L	M	H

H-High M-Medium L-Low

18PCHM302	CORE IX: INORGANIC CHEMISTRY III	SEMESTER-III

COURSE OBJECTIVES:

The course aims

- To inculcate information about the boranes, carboranes and metal clusters.
- To provide knowledge about the term symbol and energy level diagram.
- To recognize the principles and applications of photoelectron spectroscopy.
- To recognize the role of metals and ligands in biological systems.
- To gain knowledge about the uses of IR and Raman in inorganic compounds.

Credits: 5 **Total hours: 60**

UNIT	CONTENTS	Hrs	CO
I	**Boron compounds and Clusters** Boron hydrides - polyhedral boranes, hydroborateions - preparation, properties and structure - Wade's rule. Carboranes - types - preparation, properties and structure. Metallo carboranes - general study. Metal clusters – Structure of Re_2Cl_8.	12	CO1
II	**Electronic Spectra of Complexes** Spectroscopic Term symbols for d^n ions - derivation of term symbols and ground state term symbol, Hund'srule; Selection rules - break down of selection rules, spin-orbit coupling, band intensities, weak and strong field limits - correlation diagram; Energy level diagrams; Orgel and Tanabe-Sugano diagrams - effect of distortion and spin orbit coupling on spectra - Evaluation of Dq and B values for octahedral complexes of Nickel - Charge transfer spectra.	12	CO2
III	**Photoelectron Spectroscopy:** Photoelectron Spectroscopy-Principle, Photoelectric effect - PES of diatomic molecules and polyatomic molecules (HCl, HBr, HI, CO, $NH_3$and H_2O); Core electron PES; X-ray photoelectron spectroscopy (ESCA) applications.	12	CO4
IV	**Bioinorganic chemistry** Metal ions in biological systems - essential and trace metals, Na^+/K^+ Pump; Biologically important complexes of Iron (transport proteins) - haemoglobin, myoglobin, iron-sulphur proteins,	12	CO5

	cytochrome C, Magnesium (chlorophyll), Cobalt (vitamin B_{12}), Zinc (Carbonic anhydrase, carboxy peptidase) - macrocyclic effect - fixation of Nitrogen.		
V	**Lanthanides and Actinides:** Stable oxidation state – Lanthanide and actinide contraction – Difference between 4f and 5f orbital – Absorption spectra – Magnetic properties – Separation – Lanthanide Chelates. Clinical use of Lanthanum Carbonate.	12	CO5

Text Books:	
1	*Huheey, J.E, Keiter, E.A* and *Keiter, R.L.*2002. **Inorganic Chemistry Principles of structure and reactivity**. [Fourth edition]. Pearson Education, London.
2	*Cotton F.A. and Wilkinson, G.* 2007. **Advanced Inorganic Chemistry**. [Sixth Edition]. Wiley Eastern Co, New Delhi.
3	*Drago, R.S.*1992.**Physical Methods in Chemistry**. Reinhold, New York.
4	*Katja A. Strohfeldt* **Essentials of Inorganic Chemistry,** Wiley Publications.
Reference Books:	
1	*Bannerjea, D.* 2009.**Coordination Chemistry**. [Third edition] Asian publication, New York.
2	*Muller.*2006. **Inorganic Structural Chemistry**. [Fifth edition]Wiley, New York.
3	*Rao, C.N.R.* and Ferraro, J.R.1973. **Spectroscopy in Inorganic Chemistry**, vol-I, Academic press, MethvenCo, London.
4	*King, G.W.* 1964. **Spectroscopy and Molecular Structure**. Holt Rienehart and Winston. London.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Illustrate the structure of boranes, carboranes and metal clusters.
CO2	Determine the term symbol and energy level diagrams.
CO3	Apply the photoelectron spectroscopy of di and polyatomic molecule.
CO4	Describe the role of metal and complexes in biological systems.
CO5	Deduce the structure of simple molecule and ligands.

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	L
CO2	L	H	M	L	H
CO3	M	L	H	H	M
CO4	M	M	L	L	H
CO5	H	L	M	M	H

H-High M-Medium L-Low

18PCHEL301	ELECTIVE II : PHOTO CHEMISTRY	SEMESTER - III

COURSE OBJECTIVES:

The course aims

- To learn about the principles of photochemistry in various field like organic, inorganic and physical chemistry**.**
- To recognize the quantum yield of some important chemical compounds
- To acquire knowledge about photochemistry about carbonyl compounds
- To understand reactions of alkenes through photochemistry
- To recognize the reactions in aromatic compounds

Credits: 4 **Total hours: 40**

UNIT	CONTENTS	Hrs.	CO
I	Basics of photochemistry – Energy of molecules –spin multiplicity and Quantum yield, Laws of photochemistry – Grotthus-Draper law – Beer-Lambert's law – Stark-Einstein Law.Jablonski diagram – Fluorescence and its life time-Phosphoresence and its life time, Photochemical process – Primary and Secondary process – Energy transfer – Quenching and defining its terms, Excimer, Exciplex – Inter and Intramolecular energy transfer – Photosensitisation.	8	CO1
II	Quantum Yield – Experimental Determination – Light soruces – Physical actinometers – Chemical actinometers – Stermvolmer equation and its derivation – Quantum yield in photochemical reaction – Hydrogen bromide, Hydrogen iodide, Hydrogen chloride. Chemiluminescence – Photolysis – Gas phase photolysis.	8	CO2
III	**Photochemistry of carbonyl compounds** – Electronic transition – Franck Condon principle – Types of excitation – Molecular orbital view of excitation – Norrish Type I and Norrish Type II– Cycloadditionreaction -Paterno-Buchi reaction, [2+2] cycloaddition. Rearrangement of carbonyl compound – Lumiketone rearrangement, di-pi-methane rearrangement, dienone-phenol rearrangement, oxa-di-pi-methane rearrangement -1,2 –acyl shift and 1,3-acyl shift.	8	CO3
IV	**Photochemistry of olefins compounds:** Conjugated olefins – Isomerisation and rearrangements – Cis trans isomerisation – valence isomerisation – rearrangement of	8	CO4

	1,4 and 1,5 dienes – Rearrangement - Cope and Claisen and*p*-Claisen – cycloaddition reactions – Sigmatropic rearrangement.		
V	**Photochemistry of Aromatic compounds –** Arene photo isomerisation – Photo dimerisation –Cycloaddition reactions – 1, 2 cycloadditions – Photooxygenation – ene reaction - Photosensitization.	8	CO5
Text Books:			
1	*Rohatgi, K.K. Mukherjee*. 2002. **Fundamentals of Photochemistry**. [Revised edition]		
2	*Coyle. J.D.* 1986. **Photochemistry in Organic Synthesis**. Royal Society of chemistry.		
Reference Books:			
1	*Robert A. Alberty* 1997. **Physical Chemistry**. [6th Edition]. Wiley Eastern Limited		
2	Ole*Buchard, T* 1976.**Photochemistry of heterocyclic compounds**. Wiley International press.		
3	*Charles H. Depuy, Orville, S Chapman*.1988. **Molecular Reactions and Photochemistry,** Pearson Education, Limited.		

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Know the Outline of photochemistry
CO2	Illustrate the quantum yield of photochemical reaction
CO3	Predict the photochemistry of carbonyl and alkene compounds
CO4	Discuss the inorganic photochemistry reactions.
CO5	Recall the photochemistry of Aromatic compounds

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	L
CO2	L	H	M	M	H
CO3	M	L	H	H	M
CO4	M	M	L	L	H
CO5	L	L	L	M	H

H-High M-Medium L-Low

18PCHEL302	**ELECTIVE II:BIO-INORGANIC CHEMISTRY II**	**SEMESTER - III**

COURSE OBJECTIVES:

The course aims

- To understand the importance of inorganic compounds in medicinal chemistry
- To gain knowledge about essential trace elements in biological systems
- To estimate the vitality of chemicals in gastro intestinal tracks
- To know about chemicals that are important as electrolytes
- To evaluate the chemistry of radioactive chemicals in dosimetry

Credits: 4 **Total hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Essential and trace Elements in Biological Systems**: Structure and functions, effect of metal deficiency. Toxicity: mercury, cadmium, lead, beryllium, selenium and arsenic. Chelation therapy: Metals used for diagnosis and chemotherapy. Crown ether complexes of Na+ and K+ - ATP and ADP. Platinum complexes as anticancer drugs.Pt-DNA binding, complexes of gold, copper, zinc, mercury, arsenic and antimony as drugs.	8	CO1
II	**Topical Agents:** Protectives - Calamine, Talc, Zinc Oxide, Zinc Stearate, Titanium dioxide, Silicon Polymers and Dimethicone. Astringents - Zinc sulphate, Alum. Anti-infectives - Boric acid, Hydrogen peroxide, Iodine, Potassium permanganate, Chlorinated Lime.Dental Products - Anti-caries Agents -Role of Fluorides as anti-caries agents, Sodium fluoride. Dentifrices - Calcium carbonate, dibasic calcium phosphate, Zinc chloride.	8	CO2
III	**Gastro-intestinal agents:** Acidifiers and Antacids - Dilute hydrochloric acid, sodium acid phosphate, sodium bicarbonate, aluminium hydroxide gel, dried aluminium hydroxide gel, magnesium oxide (Magnesia), magnesium hydroxide mixture, magnesium trisilicate. Adsorbents and related drugs - Light kaolin, heavy kaolin, and activated charcoal. Laxatives - Magnesium sulphate, sodium phosphate.	8	CO3
IV	**Electrolytes**: Major intra and extra cellular electrolytes -	8	CO4

	Physiological role of Chloride, Phosphate, Bicarbonate, Sodium, Potassium, Calcium and Magnesium. Electrolytes used for replacement therapy - Sodium chloride, Potassium chloride, Calcium chloride, Calcium lactate, Tribasic calcium phosphate; Physiological acid-base balance: Sodium dihydrogen phosphate, Sodium acetate, Sodium bicarbonate and their importance; Dialysis fluids - Haemodialysis fluids.		
V	**Inorganic Radio-Pharmaceuticals:** Radioactivity, Units of radioactivity, radiation dosimetry, Measurement of radioactivity, Hazards and precautions in handling of radiopharmaceuticals, storage, radio pharmaceutical preparations and standards of radioactive material iodine-131 (I^{131}), Cobalt -58 (Co^{58}). Radio opaque contrast medium -barium sulphate.	8	CO5

Text Books:

1	*Artherden, L.M. Bentley* and *Driver's*, 2003. **Textbook of Pharmaceutical Chemistry**, [Eighth edition]. Oxford University Press, New Delhi. 2003.
2	*Block, J.H. Roche, Soine, E.T.O*. and *Wilson, C.O*. 1986. **Inorganic Medicinal & Pharmaceutical Chemistry,** [First edition], Varghese publishing house, Mumbai.
3	*Rao, K.S.* and *Suresh, C.V.* 2011. **Pharmaceutical Inorganic Chemistry**, Pharma Med Press.
4	*Kasture, A.V. Wadodkar, S.G.* 2008. **Pharmaceutical Chemistry-I**, [Twenty Fifth edition]. Nirali Prkashan.
5	*Rajasekaran, V. N.* 2005. **Text Book of Pharmaceutical Inorganic Chemistry Theory and Practical**, [Second edition]. Sun Publication, Chennai.

Reference Books:

1	*Chatwal*, 2007. **Pharmaceutical Chemistry Inorganic,** [Third edition]. Himalaya publishing house, Mumbai.
2	*Miessler, G.L.* and *Tarr, D.A*. 2005. Inorganic Chemistry, Pearson Education.
3	*Cowan, J. A*.1997. **Inorganic biochemistry,**Wiley-VCH, New York.
4	*Chenchu Lakshmi, N.V.*, 2012.**"Pharmaceutical Inorganic Chemistry: Theory and Practice"**[first edition]. Pearson Education, Dorling Kindersley (India) Pvt. Ltd.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the essential and trace elements in biological systems
CO2	Estimate the topical agents and its role in biological system
CO3	Demonstrate the chemical compounds as gastro intestinal agents
CO4	Predict the role of chemical compounds as electrolytes
CO5	Assess the utilization of inorganic Radio-Pharmaceuticals

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	L	M
CO2	M	L	H	M	L
CO3	L	M	M	H	L
CO4	M	H	H	H	H
CO5	H	L	M	L	M

H-High M-Medium L-Low

18PCHEL303	ELECTIVE II:POLYMER CHEMISTRY II	SEMESTER - II

COURSE OBJECTIVES:

The course aims

- To know the basic concepts of polymer, coordination in polymer, properties of commercial polymers and polymer processing
- To gain knowledge about Coordination polymerization and the catalysts that enhances
- To recognize the properties of polymer and its measurements
- To understand the processing of polymers and its types
- To cognize the properties and chemistry behind commercial polymers

Credits: 4 **Total hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Dendrimers and hyper branched polymers:** Properties of Dendrimers and Hyper branched Polymers and their Blends: Dendrimers and their structure, synthesis of Dendrimers, Hyper branched Polymers and their structure. Synthesis of hyper branched polymers, branching and polydispersity, conformation, general concepts of polymer blends. Blends of Dendritic polymers with thermoplastics.	8	CO1
II	Polymer nano composites Polyamide/clay nano composites- Synthesis, characterization and properties of Nylon 6-clayhybrid. Polystyrene/clay nano composites- Surface initiated polymerization, syndiotactic polystyrene/ clay nano composites, properties. Poly(butylenes terephthalate) (PBT) based nano composites, Epoxynano composites on layered silicates. Polypropyelene layered silicate nano composites.	8	CO2
III	Synthesis of Biomedical polymers for drug delivery Polymers as biomaterials, biomedical applications of synthetic polymers, synthetic polymers for biomedical applications, poly(α-hydroxyesters), poly(lactic acid), poly(anhydrides), poly(phosphazenes), controlled drug	8	CO3

	delivery, methods of drug delivery		
IV	Conducting polymers Correlation of chemical structure and electrical conductivity. Structure of conducting polymers Polyacetylene, polypyrrole, polythiophene, polyanilines, p-phenylene sulphide, polyphenylene vinylene. Different methods of synthesis of polyaniline. solution polymerization, interfacial polymerization, electrochemical systhesis, enzyme synthesis and photo induced polymerization of aniline. Applications of conducting polymers: Membranes and ion exchanger, corrosion protection, gas sensors, biosensors, electrocatalysis.	8	CO4
V	**Engineering plastics** Acrylonitrile butadiene styrene (ABS), Polycarbonates (PC), Polyamides (PA), Polybutylene terephthalate (PBT), Polyethylene terephthalate (PET), Polyphenylene oxide (PPO), Polysulphone (PSU), Polyetherether ketone (PEEK). Polyimides, Polyphenylene Sulphide (PPS), Syntheticroute, structure, properties and uses.	8	CO5

Text Book:

1	Gabriel, O. Shonaike & Suresh G. Advani, 2003.**Advanced polymeric materials**, CRC press.

Reference Books:

1	*Allcock, H. R* and*Lamber, F.W. 2004*. **Contemporary Polymer Chemistry.** [Third Edition]**.** Prentice Hall, New Delhi.
2	*Flory, P. J.* 1995. **Principles of Polymer Chemistry**. [First edition-16th reprint].Cornell University press, NewYork.
3	*Odian, G. 2007.* **Principles of Polymerization**. [Fourth Edition]. John Wiley & Sons, New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the basic concepts and types of polymers
CO2	Understand the role of catalyst and techniques of polymerization
CO3	Know about the properties and measurement of molecular weights
CO4	Estimate the processing techniques of polymer
CO5	Demonstrate the properties of commercial polymers

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	M	H	L
CO2	L	M	H	M	L
CO3	L	H	M	L	M
CO4	M	L	H	H	L
CO5	M	H	L	M	L

H-High M-Medium L-Low

18PCHMP301	**CORE PRACTICAL V:INORGANIC PRACTICAL II**	**SEMESTER -III**

COURSE OBJECTIVES:

The course aims

- To provide practical skills in quantitative analysis of complex materials gravimetrically
- To train the students to prepare inorganic complexes by laboratory methods

Credits: 3 **Total Hours : 50**

EXPT NO.	**CONTENTS**	**CO**
Quantitative analysis of complex materials		
1	Copper and nickel	CO1
2	Copper and Zinc	
3	Iron and nickel	
4	Calcium and magnesium	
Inorganic Preparations		
1	Sodium hexa nitro cobaltate(III)	CO2
2	Sodium Tris oxalateferrate(III)	
3	Prussianblue $Fe_4[Fe(CN)_6]_3$	
4	Bis(acetylacetanato)Copper(II)	
5	Hexamminecobalt(III) chloride	
6	Hexamminenickel(II)chloride	

Reference Books:	
1	*Venkateswaran V.* and *Kulandaivelu* A.R. 2012. **Basic Principles of Practical Chemistry.** [Second Edition]. Sultan Chand & Sons, New Delhi.
2	*Bassett J.et al.,* 1989. **Vogel's Textbook of Quantitative Inorganic Analysis.** [FifthEdition]. ELBS Longman, New York.
3	*Bajpai D.N., Pandey O.P.* and*Giri S.* 2012. B.Sc., **Practical Chemistry**, Revised Edition. S. Chand & company, New Delhi.
4	*J.P. Singh* and *G.R. Verma.* 1999. **Practical Chemistry Vol. I & II,** Revised Edition. S. Chand & company, New Delhi.
5	*Thomas. A.O.* 2000. **Practical Chemistry**. [Sixth Edition]. Sharada Press, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Estimate metals and transition metals gravimetrically
CO2	Able to prepare inorganic compounds by laboratory methods

18PCHMP302	**CORE PRACTICAL VI: PHYSICAL PRACTICAL II**	**SEMESTER - III**

COURSE OBJECTIVES:

The course aims

- Students have a practical skill on experiments in chemical kinetics, electrochemistry and polarography
- To acquire practical knowledge about kinetics

Credits: 3 **Total Hours : 50**

EXPT NO.	**CONTENTS**	**CO**
1	Determination of the activity coefficient of an electrolyte at different molalities by emf measurements	CO2
2	Determination of the dissociation constant of a weak acid.	CO1
3	Estimation of KCl by potentiometric titration.	CO2
4	Determination of the pH of a given solution by emf method.	CO1
5	Potentiometric titration of Strong acid vs Strong base	CO2
6	Determination of the strength of given Ferrous Ammonium Sulphate by potentiometric titration	CO1
7	Determination of the electrode potentials of Ag electrode.	CO2
8	Iodination of Acetone	CO2
9	Primary salt effect	CO1
10	Adsorption of Oxalic acid on Charcoal	CO1

Reference Books:	
1	*Venkateswaran V.* and *Kulandaivelu* A.R. 2012. **Basic Principles of Practical Chemistry.** [Second Edition]. Sultan Chand & Sons, New Delhi.
2	*Bassett J.et al.,* 1989. **Vogel's Textbook of Quantitative Inorganic Analysis.** [Fifth Edition]. ELBS Longman, New York.
3	*Bajpai D.N., Pandey O.P.* and *Giri S.* 2012. B.Sc., **Practical Chemistry**, Revised Edition. S. Chand & company, New Delhi.
4	*J.P. Singh* and *G.R. Verma.* 1999. **Practical Chemistry Vol. I & II,** Revised Edition. S. Chand & company, New Delhi.
5	*Thomas. A.O.* 2000. **Practical Chemistry**. [Sixth Edition]. Sharada Press, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recognize various physical techniques and principles of physical chemistry
CO2	Able to evaluate the principles of photochemistry through potentiometric techniques

18PPHCHI301	**IDC I: SOLID STATE PHYSICS**	**SEMESTER – III**

COURSE OBJECTIVES:

The course aims

- To impart knowledge on the structure of crystals, X-ray diffraction and theories of Magnetism.
- To provide basic concepts regarding dielectrics and modern engineering materials.

Credits: 4 **Total hours: 45**

UNIT	CONTENTS	Hrs	CO
I	**Introduction to crystal systems:** Crystal Lattice - Unit cell - Seven classes of crystals - Bravais lattice - Miller indices - Structure of crystals - Simple cubic structure - Hexagonal close packed structure - Face centered cubic structure - Body centered cubic structure - Sodium chloride structure - Zinc blende structure - Diamond structure.	9	CO1
II	**X-ray diffraction and crystal defects :** Diffraction of X-rays by crystals - Bragg's law in one dimension - Experimental method of X-ray diffraction - Laue method - Rotating crystal method - Powder photograph method - Point defects - Line defects - Surface defects - Volume defects - Effects of crystal imperfections.	9	CO2
III	**Theory of magnetism:** Different types of magnetic materials - Classical theory of diamagnetism (Langevin'stheory) - Langevin's theory of paramagnetism - Weiss theory of paramagnetism - Qualitative explanation of Heisenberg's internal field and quantum theory of ferromagnetism.	9	CO3
IV	**Dielectrics:** Fundamental definitions in dielectrics - Different types of dielectric polarization - frequency and temperature Effects on polarization - Dielectric loss - Qualitative study of local field or internal field - Clausius-Mossotti relation - Determination of dielectric constant - Dielectric breakdown - Properties of different types of insulating materials.	9	CO4

V	**Modern engineering materials:** Polymers – Plastics – Ceramics – Super strong materials – Cermets - High temperature materials – Thermo electric materials – Pizoelectric and pyroelectric materials –Electrets - Nuclear engineering materials - Metallic glasses - Optical materials –Fiber optic materials and uses - Super conductors - Properties - Types and applications– Shape memory alloys.	9	CO5

Text Books:

1	*Arumugam, M.* 2008. **Materials Science.** [Third Edition]. Anuradha Publications, Kumbakonam.

Reference Books:

1	*Kittel, C.* 1996. **Introduction to Solid State Physics.** [Seventh Edition]. John Wiley & Sons (Asia) Pvt. Ltd., New Delhi.
2	*Pillai, S.O*. 2005. **Solid State Physics.** New Age International, New Delhi.
3	*Rita John.*2014. **Solid State Physics.** McGraw Hill Education (India) Private Limited, New Delhi
4	*Saxena, B.S., Gupta, R.C.* and *Saxena. P.N. 2015*. **Solid State Physics.** [Twelfth Edition]. Pragati Prakashan, Meerut.

Web References:

1	https://ocw.mit.edu/courses/physics/
2	http://nptel.ac.in/courses/115105099/
3	https://www.khanacademy.org
4	https://epgp.inflibnet.ac.in/ahl.php?csrno=28

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain the concepts crystal and structure
CO2	Describe the different types of X-ray diffraction methods and crystal defects
CO3	Describe the theories about magnetic materials
CO4	Know the fundamentals of dielectric materials and their behavior
CO5	Evaluate the properties and applications of various modern engineering materials

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H
CO2	M	M	M	H	H
CO3	L	M	M	L	M
CO4	L	M	L	L	M
CO5	M	H	M	M	M

H-High M-Medium L-Low

18PCHM401	CORE X: ANALYTICAL CHEMISTRY	SEMESTER - IV

COURSE OBJECTIVES:

The course aims

- To impart knowledge about various techniques which are used in chemistry like colorimetric, voltammetry and Mass spectra etc.
- To know the different analytical techniques for inorganic chemicals
- To analyze the electrochemical methods, their principles and applications
- To recognize the chromatographic techniques, its principles and applications
- To acknowledge the surface characterization techniques for particles and its instrumentation

Credits: 5 **Total hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Data Analysis:** Errors in chemical analysis – Defining terms: Mean median, accuracy, precision and significant figures – classification of errors: Systematic errors and random errors. Improving accuracy of analysis – mean, standard deviation and Q-test. Comparison of results – Least square (regression and correlation) students' t-test, f-test and Chi square test.	10	CO1
II	**Techniques in Inorganic Chemistry**: Colorimetry: Theoretical and practical aspects of colorimetric analysis. Atomic spectroscopy – Principle - Types of atomic spectroscopy – emission methods – absorption methods – fluorescence methods; Instrumentation of atomic absorption and atomic emission spectroscopy - Application of atomic spectroscopy. Plasma sources - Atomizers for atomic spectroscopy –- flame atomizers – Eletrothermal atomizers.	10	CO2
III	**Electrochemical Methods of Analysis**: Cyclic Voltammetry and coulometery including constant current and controlled potential coulometery – principle, Experimental set-up and applications. Thermal Characterization techniques-Principle, instrumentation and applications of Differential Thermal Analysis (DTA), Differentials Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) Thermometric titration	10	CO3

IV	**Chromatographic methods:** Classification – techniques and applications - column, ion exchange, paper and thin layer chromatography. Gas chromatography and high performance liquid chromatography (HPLC) – principle, equipment design, sample injection system, columns, detectors and applications.	10	CO4
V	**Surface Characterization techniques –** Principle, instrumentation and applications of X-ray diffraction analysis (XRD), scanning electron microscopy (SEM), Transmission electron microscopy (TEM), atomic fluorescence spectroscopy (AFM) and Particle size analyzer (PSA).	10	CO5

Text Books:

1	*Skoog, D.A* and *West*, D.M. 2013. **Fundamentals of Analytical Chemistry**. [9th Edition]. Holt Rinehart and Winston Publications, London.
2	*Vogel*, *A.I.* 2012. **Text Book of Quantitative Inorganic Analysis.**[Seventh edition]Pearson Education, London.
3	*Drago,R.S., 1996.* ***P*hysical Methods in Chemistry**. Reinhold, New York.

Reference Books:

1	*Christian, G.D.*2003. **Analytical Chemistry**. [Sixth Edition]. Allyn and Bacon Inc, London.
2	*Skoog, D.A.*2014. **Principles of Instrumental Analysis**. [Seventh Edition].Saunders College Pub. Co, New Delhi.
3	*Dick, J.G.* 1974. **Analytical Chemistry** [5th Edition]. McGraw Hill Publishers, New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Know the basic concepts of errors in chemical analysis and accuracy of analysis
CO2	Demonstrate the principle, instrumentation and application of atomic spectroscopy
CO3	Illustrate the cyclic voltammetry, coulometry and thermal characterization techniques.
CO4	Recognize the chromatographic and surface characterization techniques.
CO5	Recall the characterization techniques in the study of surface of particles

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	L
CO2	L	H	M	M	H
CO3	M	L	H	H	M
CO4	M	M	L	L	H
CO5	L	L	L	M	H

H-High M-Medium L-Low

18PCHM402	CORE XI: PHYSICAL CHEMISTRY III	SEMESTER -IV

COURSE OBJECTIVES:

The course aims

- Have extended knowledge of quantum chemistry
- To gain knowledge about detailed knowledge about surface chemistry
- Estimate the principles of kinetics and various techniques to study the kinetics of reaction
- To study the principles and applications of ESR and Mossbauer spectroscopy
- To recognize the chemistry of cells, their principles and applications

Credits: 5 **Total hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Chemical Kinetics-III:** Kinetics of complex reactions–reversible reactions, consecutive reactions–Parallel reactions and Chain reactions– Chain length– Rice Herzfeld mechanism– explosion limits. **Study of Fast reactions:** Temperature and pressure jump methods, stopped flow technique and flash photolysis.	10	CO1
II	**Quantum Chemistry-III:** Theoryofchemicalbonding–Born–Oppenheimerapproximation–LCAO–MOapproximationforhydrogenmoleculeionandHydrogen–ValenceBondtheoryof Hydrogenmolecule–ComparisonofMOandVBtheories–ConceptofHybridization–sp,sp^2 and sp^3 hybridization– Huckel Molecular orbital (HMO)theory for conjugated π- system – applications to simple systems – (Ethylene, butadiene and benzene)	10	CO2
III	**ESR Spectroscopy**– ESR spectrum of an unpaired electron-hyperfine structure in ESR spectra- selection rule-hyperfine coupling constant-Spin densities–McConnell equation–g factor and coupling constants-application of ESR. **Mossbaur Spectroscopy**- Basic principles of NRS spectroscopy-Mossbauer experiment- theory-chemical shift-Nuclear electric quadrupole splitting-Nuclear Zeeman splitting.	10	CO3

IV	**Kinetics of surface reactions:** Physical and chemical adsorption – adsorption isotherms – Langmuir adsorption isotherm–B.E.T theory for multilayer adsorption – measurement of surface area – Mechanism of heterogeneous catalytic reactions– the adsorption coefficient and its significance. **Acid–Base catalysis** – Mechanism – Bronsted catalysis Law – catalysis by enzymes–rate of enzyme catalyzed reactions – effect of substrate concentration, pH and temperature on enzyme catalyzed reactions – inhibition of enzyme catalyzed reactions.	10	CO4
V	**Electrochemistry II**: Corrosion-basic principles- construction of Pourbaix diagram – Prevention of Corrosion- Passivation of metals-corrosion inhibitors. Electrochemical energy systems – Primary and Secondary batteries – Dry cells, Lead Acid. Storage batteries, silver-zinc cell, nickel-cadmium battery, mercury cell – Fuel cells – Electrodeposition – Principles and applications.	10	CO5

Text Books:

1	*Gurudeepraj*. 2014. **Advanced Physical Chemistry**. Goel Publishing House, Meerut.
2	*Laidlar, K.J.1987*. **Chemical Kinetics**. [third edition] Harper and Row, New York.
3	*Prasad R. K.* 2014. **Quantum Chemistry**. [Fifth Edition]. New age publisher. New Delhi.
4	*Drago, R.S.* 1996.**Physical Methods in Chemistry**. Reinhold, New York.
5	*Sindhu, P.S.*2011.**Fundamentals of molecular spectroscopy.** [Second edition]. New Age International (P) Ltd, Publishers, New Delhi.

Reference Books:

1	*Chandra. A.K.* 2010.**Introductory Quantum Chemistry**. [Fourth edition].Tata McGraw Hill, New Delhi.
2	*Mc Quarri, D.A.*2007. **Quantum Chemistry**. [Second edition]. University Science Books. Mill Valley, California.
3	*Barrow*,*G.M.* 1962. **Introduction to Molecular Spectroscopy**, McGraw Hill, New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Predict the basic concepts of errors in chemical analysis and accuracy of analysis
CO2	Discuss the principle, instrumentation and application of atomic spectroscopy
CO3	Illustrate the cyclic voltammetry, coulometry and thermal characterization techniques.
CO4	Recognize the chromatographic and surface characterization techniques.
CO5	Recall the electrochemical techniques and commercial usage of cells

MAPPING:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	L
CO2	L	H	M	M	H
CO3	M	L	H	H	M
CO4	M	M	L	L	H
CO5	L	L	L	M	H

H-High M-Medium L-Low

GUIDELINES

1. Submission of record note books and project dissertation:

Candidates appearing for Practical Examinations and Project Viva-voce shall submit Bonafide Record Note Books/ Record or Thesis prescribed for Practical/ Project Viva-voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project Viva-voce Examinations.

2. Passing Minimum and Internal Mark Distribution (Theory, Practical and Project)

(i) Theory

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Theory paper with a passing minimum of 38 marks in External out of 75.

Internal Marks Distribution [CA- Total Marks: 25]

Attendance	: 5 Marks
Assignment	: 5 Marks
Seminar	: 5 Marks
Internal Examinations	: 10 Marks
Total	**: 25 Marks**

(ii) Practical

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 30 marks in External out of 60.

Internal Marks Distribution [CA- Total Marks: 40]

Experiment	: 10 Marks
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations (2)	: 20 Marks
Total	**: 40 Marks**

External Marks- 60

Marks distribution given under each practical depends upon the experiments

(iii) PROJECT WORK/DISSERTATION (18PCHPR401)

- The project work shall be carried out by each student in the IV semester and has to complete the work at the end Semester.
- Upon completion of the project work/dissertation, the candidate will be required to appear for a viva-voce conducted by an external examiner.

- The Student has to attend 3 reviews before completing his/her Project.
- A candidate failing to secure the prescribed passing minimum in the dissertation shall be required to re-submit the dissertation with the necessary modifications.

Mark Distribution Pattern

Comprehensive Examination (CE)	:150 Marks
Continuous Assessment (CA)	: 50 Marks
Total	**: 200 Marks**

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 100 marks put together out of 200 in the Comprehensive Examination in each Project with a passing minimum of 75 marks in External out of 150.

***Internal Mark Distribution*[CA - Total Marks: 50 Marks]**

1. Research work done	: 20 Marks
2. Attendance	: 5 Marks
3. Observation Note	: 10 Marks
4. Reviews (3 reviews)	: 15 Marks
Total	**: 50 Marks**

(iv) CAREER COMPETENCY SKILLS

- **On Line Objective Examination (Multiple Choice questions) – Semester I**
  - 100 questions-100 minutes
  - Twenty questions from each UNIT.
  - On line examination will be conducted at the end of I Semester.

- **Viva Voce – Semester II**
  - The student has to come in proper dress code and he/she should bring 2 copies of resume for the Viva Voce
  - The student may be asked to
    - Give Self introduction
    - Submit the resume to the examiner(s) and answer the questions based on it.
    - Speak on any given topic for at least two minutes.
    - Give a presentation for 10 minutes on a topic of their choice.
    - Sit with other students in a group for a discussion.

Core Practical I: Organic Chemistry Practical I (18PCHMP101)

Organic analysis

Separation	: 5 marks
Aromatic/Aliphatic	: 4 Marks
Saturated/Unsaturated	: 4 Marks
Special elements (N/S/X)	: 6 Marks
Function groups	: 10 Marks
Derivative	: 6 Marks

Organic Preparation

Crude preparation	: 5 Marks
Recrystallization	: 10 Marks
Viva - voce examination	: 10 Marks
Total marks	**: 60 Marks**

Core Practical II: Inorganic Chemistry Practical I (18PCHMP102)

Inorganic analysis

Group separation	: 10 Marks
Cations confirmation (4x5)	: 20 Marks

Inorganic Preparation

Crude preparation	: 10 Marks
Recrystallization	: 10 Marks
Viva - voce examination	: 10 Marks
Total marks	**: 60 Marks**

Core Practical III: Organic Chemistry Practical II (18PCHMP201)

Organic estimation	: 30 Marks
Results	: 5 Marks
Organic Preparation:	
Crude preparation	: 05 Marks
Recrystallization	: 10 Marks
Viva - voce examination	: 10 Marks
Total marks	**: 60 Marks**

Percentage of error allowed in Results

0-2% -30 marks
2-3% -25 marks
3-4% -20 marks
4-5% -15 marks
>5% -10 marks

Core Practical IV: Physical Chemistry Practical I (18PCHMP202)

Formula, Table & Model graph : 20 marks
Experiment : 40 marks
Total marks : 60 Marks

Experiment which is done using instrument, the instrumental error also included and then error calculated based on the precise of the instrument by examiners at the examination.

Core Practical V:Inorganic Chemistry Practical II (18PCHMP301)

Qualitative analysis : 40 marks
Crude Preparation : 05 marks
Crystallization : 10 marks
Results : 5 marks
Total marks : 60 Marks

Percentage of error allowed in Results

0-2% -40 marks
2-3% -35 marks
3-4% -30 marks
4-5% -25 marks
>5% -10 marks

Core Practical VI: Physical Chemistry Practical I (18PCHMP302)

Formula, Table & Model graph : 20 marks
Experiment : 40 marks
Total marks : 60 Marks

Experiment which is done using instrument, the instrumental error also included and then error calculated based on the precise of the instrument by examiners at the examination.

2. Question Paper Pattern and Mark Distribution Theory

Question Paper Pattern and Mark Distribution(For 75 marks)

1. **PART – A (5 x 5 = 25 Marks)**
   Answer ALL questions
   One question from each UNIT with Internal Choice

2. **PART – B (5 x 10 = 50 Marks)**
   Answer ALL questions
   One question from each UNIT with Internal Choice