VIVEKANANDA COLLEGE

College with Potential for Excellence

Residential & Autonomous – A Gurukula Institute of Life-Training

Re-accredited (3rd Cycle) with 'A' Grade (CGPA 3.59 out of 4.00) by NAAC

Affiliated to Madurai Kamaraj University

(Managed by Sri Ramakrishna Tapovanam, Tirupparaitturai, Trichy)

TIRUVEDAKAM WEST, MADURAI DISTRICT– 625 234

www.vivekanandacollege.ac.in

Post Graduate and Research Department of Chemistry

Programme**: M.Sc. Chemistry**

CBCS and Learning Outcomes based Curriculum Framework

(LOCF)

(For those students admitted during the Academic Year 2021-22 and after)

Vision

- ✓ To prepare the students of chemistry in such a way that they are self-reliant, highly informative and a better candidate in the demanding and ever changing world.
- ✓ To prepare the knowledgeable graduates for careers in academia, industry and government.

Mission

- ✓ To foster robust degree programme that prepare students for advanced studies in chemistry and careers in chemical industry.
- ✓ To encourage students to face CSIR-NET, GATE, SET and other competitive examinations.
- ✓ To invite scientists from National/International laboratories for lectures of global standard.
- ✓ To function as a vibrant and high quality research centre by supporting the faculty involved in such pursuits.

About the Programme

M.Sc Chemistry is a Post-Graduate Degree that is pursued by a student who has an Under Graduate Degree in the relevant field. The duration of the course is 2 years with 4 semesters included in the course. A bachelor's degree of 3 years in the relevant field from a recognized university with a minimum of 50% is eligible for this course. This course deals with Chemistry as a major subject with more concerned with physical, organic, inorganic and analytical Chemistry. This course allows you to specialize in a specific field of chemistry. MSc Chemistry has a wider range of scope in various fields such as pharmaceuticals and various research-based industries.

Programme Educational Objectives (PEOs)

M.Sc., Chemistry

Programme Educational Objectives (PEOs)

PEO Number	PEO Statement
PEO1	Firm foundations in fundamentals of chemistry, effective skills to critically assess, analyse and solve problems in chemistry
PEO2	Depth knowledge to qualify CSIR–NET, SET and GATE examinations and ability in designing research methodology to pursue research
PEO3	Enormous job opportunities at all level of academic, chemical, pharmaceutical, paper, food, leather, cement and materials related industry
PEO4	Extend to continuously progress in their professional career through life long learning and respecting human values and ethics with environment concern
PEO5	Developed teamwork, leadership skills and moral values procured through life training for the welfare of their working environment and society

Programme Outcomes (PLOs)

PLO Number	Programme Outcome	PLO Statement
PLO1	Disciplinary knowledge and critical thinking	Take informed actions after identifying the assumptions that frame our thinking and actions, checking out degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from perspectives.
PLO2	Effective communication and digital literacy	Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PLO3	Research related skills and scientific	Critically analyse the research processes, products and practices with a view of strategic use of data in their field and society.

	reasoning	
PLO4	Effective citizenship and social responsibility	Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering and life training.
PLO5	Team work and leadership quality	Inculcating team spirit and leadership quality to carry out the mission where the student will work or serve.
PLO6	Environment, ethics and values	Understand the issues of environmental contexts and recognize different value systems, the moral dimensions of their decisions, and accept responsibility for them.
PLO7	Self –directed and life – long learning	Acquire the ability to engage in independent and life – long learning in the broadest context socio- technological changes.

Programme Specific Outcomes (PSOs)

PSO Number	PSO Statement
PSO1	Have a firm foundation in the fundamentals of chemistry and their recent trends.
PSO2	Understand, identify, articulate, analyze and solve the problems pertaining to the concepts of chemistry and their related issues.
PSO3	Synthesize, compare, evaluate, classify, interpret and utilize the basic laws, principle, chemical phenomena, processes, reaction mechanisms involved in the topics of chemistry, chemical experiments and scientific problems.
PSO4	Make use of modern instrumentation, online searching methods to obtain information about chemicals, chemical techniques, chemistry models or an issue relating to chemistry.
PSO5	Explicitly communicate and exchange their ideas in view of the theoretical and experimental findings, impact of chemistry on environment and society to the chemist and non-chemist.

Assessment

Post Graduate Programmes - Question Paper Pattern for Both CIA & End Semester Examinations

With Effect From: 2021-22 onwards

Part III (Core, Allied &Elective)

CIA Test Question Paper Pattern (UG) – 3 Tests per Semester – 2 Hours

Section - A: MCQs (Compulsory)	10 X 1=10 Marks
Section - B: VSA (5 out of 7)	5 X 2 = 10 Marks
Section - C: SA (3 out of 5)	3 X 6 = 18 Marks
Section - D: LA (1 out of 2)	1 X 12=12 Marks

Total	**50 Marks**

End Semester Examinations Question Paper Pattern (UG) – 3 Hours

Section - A: MCQs	10 X 1 =10 Marks **(From Question Bank given by the Course Teacher)**
Section - B: VSA (5 out of 7)	5 X 2 =10 Marks
Section - C: SA (Either-or)	5 X 5= 25 Marks
Section - D: LA (3 out of 5)	3 X 10 =30 Marks

Total	**75 Marks**

CIA Test Question Paper Pattern (UG) – 3 Tests per Semester at Department Level– 1 Hour

Section - A: MCQs	5 X 1 = 5Marks
Section - B: VSA (2 out of 4)	2 X 2 = 4 Marks
Section - C: SA (1 out of 2)	1 X 6 = 6 Marks
Section - D: LA (1 out of 2)	1 X 10=10 Marks

Total	**25 Marks**

For competitive exam questions Pattern (OMR with 4 options will be used) 50X1=50 (**1 hour**)

End Semester Examinations Question Paper Pattern (UG) – 2 Hours

Section - A: MCQs	10 X 1 = 10 Marks **(From Question Bank given by the Course Teacher)**
Section - B: VSA (5 out of 7)	5 X 2 = 10 Marks
Section - C: SA (Either-or)	3 X 9 = 27 Marks
Section - D: LA (2 out of 4)	2 X 14= 28 Marks

Total	**75 Marks**

For competitive exam questions Pattern (OMR with 4 options will be used) 75X1=75 (**2 hours**)

Part VI (End Semester Examinations only) UG & PG

1. General Knowledge **– (One Examination per Semester– UG & PG) – 1 Hour**

Section – A: MCQs	50 X 1 =50 Marks (**OMR Sheet**)

Total	**50** Marks
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2. Wit for Wisdom and Humour for Health – (One Examination per Year – UG & PG) – 1 Hour

Section – A: LA (5 out of 7)	5 X 20= 100 Marks

Total	**100** Marks
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3. Spiritual Education– (One Examination per Year – UG & PG) – 1 Hour

Section – A: VSA	20 X 2= 40 Marks
Section – B: SA (3 out of 5)	3 X 5 = 15 Marks
Section –C: LA (2 out of 4)	2 X 10 =20 Marks

Total	**75** Marks
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4. Physical Training– (One Examination for III Year UG & II Year PG Students) – 1 Hour

Section - A: MCQs	10 X 1 = 10 Marks
Section – B: SA ((Either-or))	4 X 5 = 20 Marks
Section – C: LA (2 out of 4)	2 X 10 =20 Marks

Total	**50** Marks

Continuous Internal Assessment (CIA) - Distribution of Marks

	UG		PG	
Part - I, II Part - III	Test (Best Two)	15 Marks	Test (Best Two)	15 Marks
	Cycle Test (5 × 1 = 5)	5 Marks	Quiz / Seminar	5 Marks
	Assignment (5 × 1 = 5)	5 Marks	Assignment	5 Marks
	Total	**25 Marks**	**Total**	**25 Marks**
Part- IV	Test (Best Two for SBS)	20 Marks		
	Assignment	5 Marks		
	Total	**25 Marks**		

Abbreviations:

MCQs: Multiple Choice Questions
SA : Short Answer
VSA: Very Short Answer
LA : Long Answer

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry (Under CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22 and after)

SCHEME OF EXAMINATION

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry (Under CBCS and LOCF)

(For those students who admitted during the Academic Year 2021 and after)

SCHEME OF EXAMINATION

FIRST SEMESTER

Part	Study Component	Course Code	Title of the Paper	Hours	Credit	CIA Marks	END SEME. Marks	Total
III	Core	33CC11	Organic Chemistry – I	5	4	25	75	100
	Core	33CC12	Inorganic Chemistry – I	5	4	25	75	100
	Core	33CC13	Physical Chemistry – I	5	4	25	75	100
	Core	33CP14	Organic Analysis	5	3	40	60	100
	Core	33CP15	Inorganic Qualitative Analysis	5	3	40	60	100
	Discipline Specific Elective	33DS1A 33DS1B	Industrial Chemistry and Intellectual Property Rights /Computer Applications in Chemistry	5	5	25	75	100
			TOTAL	**30**	**23**			**600**

SECOND SEMESTER

Part	Study Component	Course Code	Course Title	Hours	Credit	CIA Marks	END SEME. Marks	Total
III	Core	33CC21	Organic Chemistry – II	5	4	25	75	100
	Core	33CC22	Inorganic Chemistry – II	5	4	25	75	100
	Core	33CC23	Physical Chemistry – II	5	4	25	75	100
	Core	33CP24	Organic Preparation and Quantitative Estimation	5	3	40	60	100
	Core	33CP25	Practical Physical Chemistry	5	3	40	60	100
	Discipline Specific Elective	33DS2A 33DS2B	Medicinal and Pharmaceutical Chemistry / Biochemistry	5	5	25	75	100
			TOTAL	**30**	**23**			**600**

THIRD SEMESTER

Part	Study Component	Course Code	Course Title	Hours	Credit	CIA Marks	END SEME. Marks	Total
III	Core	33CC31	Organic Chemistry – III	5	4	25	75	100
	Core	33CC32	Inorganic Chemistry –III	5	4	25	75	100
	Core	33CC33	Physical Chemistry – III	5	4	25	75	100
	Core	33CP34	Inorganic Quantitative Estimation	5	3	40	60	100
	Core	33PV41	Project and Viva -Voce	5	-	-	-	
	Generic Elective Course	33GE31	Forensic Chemistry	5	5	25	75	100
			TOTAL	**30**	**20**			**500**

FOURTH SEMESTER

Part	Study Component	Course Code	Course Title	Hours	Credit	CIA Marks	END SEME. Marks	Total
III	Core	33CC41	Organic Chemistry – IV	5	4	25	75	100
	Core	33CC42	Inorganic Chemistry – IV	5	4	25	75	100
	Core	33CC43	Physical Chemistry – IV	5	4	25	75	100
	Core	33PV41	Project and Viva - Voce	10	7	40	60	100
	Discipline Specfic Elective	33DS4A	Chemistry for National Eligibility Test	5	5	25	75	100
		33DS4B	Introduction to Nano Science					
			TOTAL	**30**	**24**			**500**
All End semester practical Examinations = 6 Hrs								
			Total Hours	**120**				
			Total Credits		**90**			
			Total Marks					**2200**

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **I**
Course Title: **ORGANIC CHEMISTRY - I**		
Course Code: **33CC11**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Develop an understanding of reactivity of organic compounds, reaction mechanisms and to know the chemistry of organic molecules based on stereochemistry.
- ✓ Understand the symmetry operations and identify the stereo centers and assign the configuration of the molecule
- ✓ Know and understand the chemistry of carbohydrates, selected terpenes and alkaloids.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO 1	Define, demonstrate and apply the electron displacement effects and its significance	K1, K2&K3
CLO 2	Compare, organize and examine the stability of various reactive intermediates and determination of reaction mechanism	K2, K3&K4
CLO3	Relate, explain and categorize the concept of aromaticity	K1, K2&K4
CLO 4	Show the R/S and E/Z nomenclature for organic compounds and organize and categorize topical relationship	K1, K3 &K4
CLO 5	Illustrate the chemistry of disaccharides, trisaccharides and infer the structural elucidation of selected terpenes and alkaloids.	K2 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	1	1	1	3
CLO 2	9	1	3	1	1	1	3
CLO 3	9	1	3	1	1	1	3
CLO 4	9	1	3	1	1	1	3
CLO 5	9	1	3	1	1	1	3
Weightage of the course	45	5	15	5	5	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	1	1
CLO 2	9	9	3	1	1
CLO 3	9	9	3	1	1
CLO 4	9	9	3	1	1
CLO 5	9	9	3	1	1
Weightage of the course	45	45	15	5	5

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: ELECTRON DISPLACEMENT EFFECT

Inductive effect and field effect – bond distances – bond energy – delocalized bonds – cross conjugation – rules of resonance – resonance energy – resonance effect – steric inhibition of resonance – hyper conjugation – hydrogen bonding – addition compounds – EDA complexes – crown ether complexes – inclusion compounds – effects of structure on the association constants of acids and bases – concept of hard and soft acids and bases.

UNIT-II: INTRODUCTION TO REACTION MECHANISM

Reaction intermediates: Free radicals, carbenes, nitrenes, carbanions, carbocations – formation and stability of reaction intermediates – methods of determination of reaction mechanism – kinetic and thermodynamic control of chemical reactions – kinetic and non-kinetic methods for determining organic reaction mechanism – principle of microscopic reversibility – energy profile diagram – Hammond's postulate.

UNIT-III: AROMATIC CHARACTER

Aromatic character in benzene – six-member rings, five, seven and eight member rings – other systems with aromatic sextets – Huckel's rule – Craig's rule – concept of homoaromatic and antiaromatic – systems with 2,4,8 and 10 electromagnetic systems with more than 10 electron – alternant and non-alternant hydrocarbons – chemical of cyclopentadienyl anion – fulvene, azulene, tropolones, syndnones and annulenes.

Novel ring systems: Nomenclature of bicycle and tricyclic systems – adamantane, diamantane, cubane and catenanes.

UNIT-IV: STEREOCHEMISTRY

Symmetry elements – optical activity – chirality – asymmetry and dissymmetry – enantiomers and diastereomers – Fischer projections – absolute configurations – Cahn-Ingold-Prelog rules – E, Z nomenclature – asymmetric synthesis – asymmetric catalyst – chiral auxiliaries – optical purity and enantiomeric excess – enantiotopic and diastereotopic atoms.

Stereoselectivity and stereospecificity – enantioselective and diastereoselective representative reactions – role of enzymes – optical activity and stereochemistry of biphenyl, allenes and spirans – molecular overcrowding – optical activity of compounds containing nitrogen and sulphur – use of spectroscopic methods in determining configurations of geometrical isomers – stereoisomerism of cyclic compounds – three, four and five membered ring systems.

UNIT-V: NATURAL PRODUCTS

Carbohydrates: Configuration and conformation of aldohexopyranoses – structure and synthesis of disaccharides – maltose, lactose, sucrose – polysaccharides – starch and cellulose – chemistry of amino sugars – methods of determining the size of the sugar rings – cyclodextrins.

Terpenes: Structural elucidation of α-santonine and zingiberene.

Alkaloids: General methods of determining.

Reference Books

1. March, J, *Advanced organic Chemistry – Reactions, Mechanism and structure*, 4th Ed., John Wiley and sons, 2007.
2. Clayden, J, Greeves, N. and Warren, S. *Organic Chemistry*, 2nd Ed.,OXFORD University Press, 2014.
3. Norman, R.O.C, and Coxan, J.M, *Principles of Organic Synthesis*, 3rd Ed., Nelson Thomes, 2001.
4. Carey, F.A. and Sunberg, R.J, *Advanced Organic Chemistry*, Part A and Part B, Kluwer Academic/Plenum Publishers, 2004.
5. Sykes, P. *A Guide book to Mechanism in Organic Chemistry*, 6th Ed., Orient Longman Ltd., 1997.
6. Mukherjee, S.M. and Singh, S.P. *Reaction Mechanism in Organic Chemistry*, 1st Ed., Macmillan India Ltd., 1990.
7. Kalsi, P.S. *Stereochemistry, conformation and mechanism*, 4th Ed.,Wiley Eastern Ltd., 2006.
8. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata-McGraw Hill, 2000.
9. Nasipuri, D. *Stereochemistry of organic compounds, Principles and application*, 2nd Ed., Wiley Eastern Ltd.,2006.
10. Agarwal, O.P. *Chemistry of Organic Natural products*, Vol I - 37th & II 34thEd., GOEL publishing House, Meerut, 2008.
11. Finar, I.L. *Organic Chemistry*, Vol – II, 5th Ed., ELBS Longman, 1975.

E-Resources

1. https://fdocuments.in/document/electron-displacement-effect.html
2. https://www.youtube.com/watch?v=7wn8kHqLvYc
3. https://www.slideshare.net/PoojaThakral2/aromaticity-antiaromaticity-non-aromaticity
4. https://www.youtube.com/watch?v=ze8vOcb8clY
5. https://www.youtube.com/watch?v=OxQzr6tXYFQ

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **I**
Course Title: **INORGANIC CHEMISTRY - I**		
Course Code: **33CC12**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Understand the structure and bonding in molecules and gain knowledge about main group elements.
- ✓ Learn the various concepts of acids and bases and know the importance of non-aqueous solvents
- ✓ Understand the basics of nuclear chemistry

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Relate and explain the chemistry and theories involved in ionic compounds	K1 & K2
CLO2	Make use of VSEPR theory to predict the shapes of molecules and compare the bonding theories	K3& K4
CLO3	Compare and contrast the various concepts of acids and bases and classify the hard and soft acids and bases	K2 & K4
CLO4	Relate, summarize and classify the types and uses of boranes, silicates and carbides.	K1,K2 & K4
CLO5	Define the basic concepts of nuclear chemistry and explain the types of nuclear reaction.	K1 & K2

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	3	1	3	1	1	3
CLO 2	9	3	1	3	1	1	3
CLO 3	9	3	1	3	1	1	3
CLO 4	9	3	1	3	1	1	3
CLO 5	9	3	1	3	1	1	3
Weightage of the course	45	15	5	15	5	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	1	3
CLO 2	9	9	3	1	3
CLO 3	9	9	3	1	1
CLO 4	9	9	3	1	1
CLO 5	9	9	3	1	3
Weightage of the course	45	45	5	5	11

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: THE IONIC BOND

Chemical bond: Types of bonds – ionic bond – properties of ionic compounds – factors favouring the formation of ionic compounds – ionization potential – electron affinity and electronegativity.

Lattice energy: Definition – Born-Lande equation – factors affecting lattice energy – Born-Haber cycle – enthalpy of formation of ionic compounds and stability – calculation of ionic radius – Pauling's method and Linde's method – effective nuclear charge – Slater's rule – covalent character in ionic compounds – polarization and Fajan's rules – effects of polarization – solubility – melting points and thermal stability of typical ionic compounds.

UNIT-II: THE COVALENT BOND AND WEAK CHEMICAL FORCES

Lewis structures – valence bond theory and its limitation – hybridization and geometry – VSEPR theory – regular and irregular geometry (shapes of $BeCl_2$, BH_3, SiF_4, PF_5, SF_6, IF_7, $SnCl_2$, NH_3, H_2O, SF_4, ClF_3, XeF_2, XeF_4, IF_5, $CLO3^{2-}$, SO_4^{2-} and I_3^-) – Bent's rule – molecular orbital theory – linear combination of atomic orbitals – bonding, anti-bonding and non-bonding molecular orbitals – MOs of homonuclear diatomic molecules (H_2, O_2 and N_2) – bond strength and bond order of heteronuclear diatomic molecules (CO, NO and HF) – comparison of VBT and MOT.

Hydrogen bonding – nature and its types – consequences and importance of hydrogen bonding.

Intermolecular forces – dipole-dipole, induced dipole-induced dipole interactions.

UNIT-III: ACIDS AND BASES & NON-AQUEOUS SOLVENTS

Acid-base concept: Bronsted-Lowry definition – Lux-Flood definition – solvent system definition – Lewis definition – Usanovich definition.

Hard and soft acids and bases: Classification of acids and bases as hard or soft – symbiosis – theoretical basis of hardness and softness – HSAB principle and its applications.

Non-aqueous solvents: Classification of solvents, study of following non-aqueous solvents such as liquid NH_3, SO_2, N_2O_4, HF and acetic acid.

UNIT-IV: MAIN GROUP ELEMNTS

Boranes: Preparation, properties, structure and bonding of diborane – bonding in boranes – *styx* number – Wade's rule – carboranes – preparation and structure of borazine.
Carbides: Classification – salt-like carbides – covalent carbides and interstitial carbides – uses of carbides.
Silicates: Different types of silicates – ortho, pyro, cyclic, chain, sheet, three dimensional silicates – synthesis, structure and bonding in polyanions and isopolyanions of phosphorous, vanadium, chromium, molybdenum and tungsten – hetero poly anions of molybdenum and tungsten.
Chemistry of S-N compounds – synthesis and reactivity of S_4N_4 and S_2N_2.

UNIT-V: NUCLEAR CHEMISTRY

Composition of nucleus – nuclear size – nuclear forces – packing fraction – nuclear density – mass defect – binding energy of the nucleus – nuclear models – concept of nuclear spin.
Radioactivity: Radioactive disintegration – radioactive decay and half-life – radioactive equilibrium – steady state – transmutation of elements – group displacement rule – nuclear stability – radioactive series – isotopes, isobars, isotones – separation of isotopes – determination of atomic masses – artificial radioactivity and induced radioactivity – transuranic elements – nuclear coulombic energy barrier – q values of nuclear reactions – nuclear fission and nuclear fusion – Detectors: Scintillation counter – gas ionization chamber – proportional counter and Cherenkov counter – Accelerators: Cyclotron – synchrocyclotron – betatron – Applications of radioactivity: Activation analysis – isotopic dilution technique – radiometric titration.

Reference Books

1. Huheey, J.E., Keiter, E.A. and Keiter, R.L. *Inorganic Chemistry: Principles of structure and reactivity*, 4th Ed., Pearson Education Pte. Ltd., Delhi, 2004.
2. Atkins, P.W., Overton, T.L., Rourke, J.P., Weller, M.T. and Armstrong, F.A. *Inorganic Chemistry*, 4th Ed., Oxford University Press, 2010.
3. Cotton, F. A., Wilkinson, G., Murillo, C.A. and Bochmann, M. *Advanced Inorganic Chemistry*, 6th Ed., Wiley India Pvt. Ltd., Delhi, 2015.
4. Purcell K.F. and Kotz J.C. *Inorganic Chemistry*, Cengage Learning India Private Limited, New Delhi, 2017.
5. Meissler, G.L. and Tarr, D.A. *Inorganic Chemistry*, 3rd Ed., Pearson India Education Services Pvt. Ltd., 2015.
6. Douglas, B., McDaniel, D. and Alexandar, J., *Concepts and Models of Inorganic Chemistry*, 3rd Ed., Wiley India Pvt. Ltd., Delhi, 2015.
7. Weller, M., Overton, T., Rourke, J. and Armstrong, F., *Inorganic Chemistry*, 6th Ed., Oxford University Press, New Delhi, 2015.
8. Lee, J.D. *Concise Inorganic Chemistry*, 6th Ed., Blackwell Science Ltd., 2006.
9. Puri, B.R., Sharma, L.R. and Kalia, K.C., *Principles of Inorganic Chemistry*, 33rd Ed., Vishal Publishing, 2017.
10. Malik, W.U., Tuli, G. D. and Madan, R.D. *Selected Topics in Inorganic Chemistry*, I st Ed., S. Chand & Company Ltd., 2008.
11. Arnikar, H.J. *Essentials of Nuclear Chemistry*, 4th Ed., New Age International, New Delhi, 1995.

E-RESOURCES

1. https://nptel.ac.in/courses/104/101/104101121/
2. https://nptel.ac.in/courses/104/101/104101090/
3. https://nptel.ac.in/courses/104/103/104103069/
4. https://nptel.ac.in/courses/115/104/115104043/

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **I**
Course Title: **PHYSICAL CHEMISTRY - I**		
Course Code: **33CC13**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ have a good foundation in quantum mechanics.
- ✓ understand the basic concepts of classical thermodynamics, chemical kinetics, gaseous state and liquid state.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Spell and interpret the basic concepts of quantum mechanics	K1 & K2
CLO2	Summarize and make use of the applications of quantum mechanics	K2 & K3
CLO3	Extend, utilize and analyze the principle and concept of chemical thermodynamics	K2, K3 & K4
CLO4	Relate, illustrate and organize the theories of chemical kinetics	K1, K2 & K3
CLO5	Define and demonstrate the phenomena involved in gaseous and liquid state	K1 & K2

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	1	3	1	3
CLO 2	9	1	3	1	3	1	3
CLO 3	9	1	3	1	3	1	3
CLO 4	9	1	3	1	3	1	3
CLO 5	9	1	3	1	3	1	3
Weightage of the course	45	5	15	5	15	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	1	3
CLO 2	9	9	3	1	3
CLO 3	9	9	3	1	3
CLO 4	9	9	3	1	3
CLO 5	9	9	3	1	3
Weightage of the course	45	45	15	5	15

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: QUANTUM MECHANICS – I

Black body radiation – de-Broglie's wave particle duality – experimental verification of matter waves – photo electric effect – Compton effect – Heisenberg's uncertainty principle – postulates of quantum mechanics.

Operators: linear and non-linear operators, Hermitian operators – momentum – kinetic energy, total energy – angular momentum – proving operators are Hermitian commutator algebra – evaluation of commutators – introducing Dirac notation – eigen function, eigen value and degeneracy – setting up of Schrodinger wave equation – interpretation of wave function, orthogonal function – expansion theorem – Schmidt orthogonalisation.

UNIT-II: QUANTUM MECHANICS – II

Application of Schrodinger wave equation to free particle moving in one dimension – particle moving in a one-dimension box with zero potential energy inside and infinite potential outside – particle moving in 3D cubical and rectangular box – quantum mechanical tunnelling and transmission coefficient – particle in a ring – simple harmonic oscillator – 3D uncoupled isotropic harmonic oscillator – rigid rotator – hydrogen atom – radial distribution functions – spherical harmonics – shapes of various orbitals (1s, 2s, 2p) – angular momentum – spin momentum.

UNIT-III: CHEMICAL THEROMODYNAMICS

Thermodynamic equation of state, derivation and their application to non-ideal gases –calculation of $(\Delta H/\partial P)_T$, $(\Delta E/\partial V)_T$ and μ_{JT} – thermodynamics of system of variable composition – partial molal quantities – chemical potential – relationship between partial molal quantities – determination of partial molal quantities – Gibbs-Duhem equation – thermodynamic properties of real gases – fugacity concept – determination of fugacity of real gases – activity concepts of condensed states – choice of standard states – determination of activity and activity coefficients – basic concepts of non-equilibrium thermodynamics – Onsager reciprocal relationships – microscopic reversibility (concept only derivation not necessary).

UNIT-IV: CHEMICAL KINETICS

Simple collision theory – potential energy surfaces – absolute reaction rate theory – thermodynamic treatment – comparison of ARRT and collision theories – application of ARRT to simple bimolecular process – steady state approximation – theory of unimolecular reactions – Lindemann, Hinshelwood, RRKM

and Slater treatments – reactions in solutions – factors influencing reaction rate in solution – significance of activation – salt effect and kinetic isotope effect.

UNIT-V: GASEOUS AND LIQUID STATE

Maxwell distribution of molecular velocities – derivation and experimental verification – types of velocities – energy distribution – Maxwell-Boltzmann distribution Law – equipartition principle and heat capacity – mean free path – molecular collisions – transport properties – thermal conductivity – viscosity and diffusion. Structure of liquids – X-ray method – internal pressure – liquid crystals – theory and applications.

Reference Books

1. Puri, B.R., Sharma L.R., and Pathania, M.S. *Principles of Physical Chemistry*, 46th Ed., Vishal Publishing Co., 2014.
2. Prasad, R.K., *Quantum chemistry*, 4th Ed., New Age International (P) Ltd., Publishers, 2010.
3. McQuarrie, D.A. *Quantum Chemistry*, 2nd Ed., University Science Books, California, 2008.
4. Atkins, P.W. and Friedman. R. *Molecular Quantum Mechanics,* 5th Ed., Oxford university Press, 2011.
5. Klotz, I.M. and Rosenberg, R.M. *Chemical thermodynamics*, 6th Ed., W.A. Benjamin Publishers, California, 1972.
6. McQuarrie, D.A. and Simon, J.D. *Physical Chemistry, A Molecular Approach*, Viva Books Pvt. Ltd., New Delhi, 1999.
7. Rastogi, R.P. and Misra, R.R. *Classical Thermodynamic*s, Vikas Publishing, Pvt. Ltd., New Delhi, 1990.
8. Maron, S.H. and Lando, J.B. *Fundamentals of Physical chemistry,* MacMillan Publishers, New York, 1974.
9. Laideler, K.J. and Meiser, J.M. *Physical Chemistry,* 3rd Ed., International,1999.
10. Barrow, G.M., *Physical Chemistry*, 5th Ed., McGraw Hill Education, 2006.
11. Maron, S.H. and Prutton, C.F. *Principles of Physical Chemistry*, 4th Ed., Oxford & IBH publishing co.Pvt.Ltd., New Delhi, 1972.

E-Resources

1. https://nptel.ac.in/courses/104/101/104101126/
2. https://nptel.ac.in/courses/104/108/104108057/
3. https://nptel.ac.in/courses/103/101/103101004/
4. https://nptel.ac.in/courses/104/105/104105041/
5. https://nptel.ac.in/courses/112/105/112105123/

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Practical**		SEMESTER **I**
Course Title: **ORGANIC ANALYSIS**		
Course Code: **33CP14**	Hours per week: **5**	Credits: **4**
CIA Marks: **40 Marks**	ESE Marks: **60 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Separate the organic mixture and identify its composition
- ✓ apply the skill in preparation, purification and recrystallizationof organic compounds

Course learning Outcomes (CLO)

On successful completion of the course, the student will be able to

CLO	CLO Statement	Knowledge level
CLO1	Examine and identify special element, aromatic and aliphatic nature of organic compound	K4
CLO2	Examine and identification of special element, aromatic and aliphatic nature of organic compound	K4
CLO3	Make use of synthetic strategy to prepare organic compounds	K3
CLO4	Make use of synthetic strategy to prepare organic compounds	K3
CLO5	Make use of synthetic strategy to prepare organic compounds	K3

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Syllabus

UNIT-I

Separation of two component and characterization.

1. Acid substance and neutral substance
2. Basic substance and neutral substance

UNIT-II

1. Phenolic substance and neutral substance
2. Acid substance and phenolic substance
3. Phenolic substance and basic substance

UNIT-III

Single stage preparations and purification by recrystallization technique

1. Acetylation (acetanilide from aniline)
2. Hydrolysis (salicylic acid from methyl salicylate)
3. Bromination (tribromoaniline from aniline)

UNIT-IV

1. Benzoylation (benzanilide from aniline)
2. Diazotisation (methyl orange from sulphanilic acid)
3. Nitration (picric acid from phenol)

UNIT-V

1. Benzophenone oxime from benzophenone
2. Anthranilic acid from pthalimide

Note: a) A minimum of six organic mixtures & six preparations should be done by each student.
b) Each student is expected to submit both crude and recrystallized samples of the preparation during their regular practical for evaluation at the time of practical examinations.

Reference Books

1. Gnanapragasam, N.S. and Ramamuthy, G. *Organic Chemistry – lab manual*, S.ViswanatahanCo. Pvt, Ltd.,1998.
2. Vishnoi, N.K. A*dvanced practical organic chemistry*, Vikas Publishing House Pvt. Ltd., 1982.
3. Vogel, A.I. *Vogel's Textbook of Practical Organic Chemistry*, 4th Ed., Longmann group, 2008.
4. LAB MANUAL - Prepared by Faculty, Department of Chemistry, Vivekananda College.

E-Resources

1. https://www.youtube.com/watch?v=YTH9RU-xzqM
2. https://www.youtube.com/watch?v=FUo428guKt0
3. https://www.youtube.com/watch?v=n4esSHxz_J8
4. https://www.youtube.com/watch?v=FuqNEIfsE-Q
5. https://www.youtube.com/watch?v=g5nfiFMCkbQ

Distribution of marks

Max marks: 100

Internal	**: 40 marks**	**External**	**: 60 marks**
Attendance	: 5 marks	Organic analysis	: 30 marks
Laboratory performance and model practical	: 20 marks	Organic preparation	: 10 marks
		Record note book	: 10 marks
Viva-voce	: 5 marks	Viva-voce	: 10 marks
Observation note book	: 10 marks		
Total	: 40 marks	Total	: 60 marks

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Practical**		SEMESTER **I**
Course Title**: INORGANIC QUALITATIVE ANALYSIS**		
Course Code: **33CP15**	Hours per week: **5**	Credits: **4**
CIA Marks: **40 Marks**	ESE Marks: **60 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ develop skills in identification of elements by inorganic qualitative analysis.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to:

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO 1	Analyze most common and less common ions by using semi-micro inorganic qualitative methods	K4
CLO2		
CLO3		
CLO4		
CLO5		

K1-Remembering K2-Understanding K3-Apply

Syllabus

UNIT-I

Analysis common metal cations: Pb, Cu, Mn, Cr, Al, Ni, Co, Ba, Sr, Mg

UNIT-II

Analysis of less common metal cations: W, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li

UNIT-III

Analysis of mixtures containing two common and two less common cations (practical I to III)

UNIT-IV

Analysis of mixtures containing two common and two less common cations (practical IV to VI)

UNIT-V

Analysis of mixtures containing two common and two less common cations (practical VII to IX)

Reference Books

1. Ramanujam, V.V. *Inorganic semi – micro qualitative analysis*, the National Publishing Company, 3rd Ed., 2008.
2. Vogel, A.I. *Elementary Practical Organic Chemistry*, Part III- Quantitative Organic analysis – Longmann London, 4th Ed., 1987.

E-Resources

1. https://www.youtube.com/watch?v=yMChYvgTfkQ
2. https://www.youtube.com/watch?v=WIxhmGbWk94
3. https://www.youtube.com/watch?v=XZB261mv4bQ
4. https://www.youtube.com/watch?v=UGczbI9gy1U

Distribution of marks

Max marks: 100

Internal	**: 40 marks**	**External**	**: 60 marks**
Attendance	: 5 marks	Four radical with correct procedure	: 40 marks
Laboratory performance and model practical	: 20 marks	Record note book	: 10 marks
Viva-voce	: 5 marks	Viva-voce	: 10 marks
Observation note book	: 10 marks		
Total	: 40 marks	Total	: 60 marks

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Discipline Specific Elective**		SEMESTER **I**
Course Title: **INDUSTRIAL CHEMISTRY AND INTELLECTUAL PROPERTY RIGHTS**		
Course Code: **33DS1A**	Hours per week: **5**	Credits: **5**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Gain knowledge about fuels, cements, fertilizers, paints and pigments
- ✓ Give an idea about IPR, copyrights, patents and its enforcement.
- ✓

Course Learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO 1	Define, illustrate and analyze the importance of fuels	K1, K2 & K4
CLO 2	List, compare and organize the utility and importance of cements and fertilizers	K1, K2 & K3
CLO3	Demonstrate and compare the chemistry of paints and pigments	K2 & K4
CLO 4	Examine and illustrate the concept of intellectual property right	K2 & K3
CLO 5	Understand and apply the ides of copyrights, trademarks. patents and geographical indications	K2 & K3

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	3	1	1	1	1	1	3
CLO 2	3	1	1	1	1	1	3
CLO 3	3	1	1	1	1	1	3
CLO 4	3	1	1	1	1	1	3
CLO 5	3	1	1	1	1	1	3
Weightage of the course	15	5	5	5	5	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	1	1	1	1
CLO 2	3	1	1	1	1
CLO 3	3	1	1	1	1
CLO 4	3	1	1	1	1
CLO 5	3	1	1	1	1
Weightage of the course	15	5	5	5	5

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: FUELS

Introduction – calorific value of fuels and its determination – classification of fuels – solid, liquid and gaseous – criterion of selection of fuel – refining of crude petroleum and uses of fractions – cracking – thermal and catalytic – octane number – production and uses of tetraethyl lead – introduction to biofuel.

UNIT-II: CEMENTS AND FERTILIZERS

Cements: Types – Portland, slag and white – raw materials – manufacture of cement – setting of cement – Indian standards institute specifications - testing of cement.

Fertilizers: Micronutrients and their role – essential requirements of a fertilizer –classifications – straight and mixed fertilizers – manufacture and uses of ammonium sulphate – NPK and triple superphosphate – introduction to bio fertilizers.

UNIT-III: PAINTS AND PIGMENTS

Paints: Constituents of paints – manufacture – setting – requirements of a good paint – classifications – emulsion, fire retardant, latex and heat resistant paints – paint removers – varnishes.

Pigments: Manufacture – characteristics and uses of white pigment – white lead and zinc oxide (French process) – red pigments (red lead) – green pigment (chrome green).

UNIT-IV: INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS

Introduction: Historical perspective – different types of IP – need for intellectual property right – economic importance – IPR in India and world – genesis and scope – important examples of IPR.

Different international agreements: Basic idea of general agreement on tariffs &trade (GATT) – Trade Related Intellectual Property Rights (TRIPS) – agreement and General Agreement on Trade in Services (GATS).

UNIT-V: COPYRIGHTS, TRADEMARKS, PATENTS AND GEOGRAPHICAL INDICATIONS

Copyrights: Work protected under copyright laws – rights – transfer of copyright – infringement.

Trademarks: Objectives of trademarks – types – protection of goodwill – infringement – domain name.

Patents: Procedure of obtaining patents – working of patents – infringement of patents.

Geographical Indications: Rules for registration – importance – prevention of illegal exploitation.

Reference Books

1. Jain, P.C. and Jain, M. *Engineering Chemistry*, 16th Ed., DhanpatRai Publishing Company, New. Delhi, 2017.

2. Kuriakose, J.C. and Rajaram, J. *Chemistry in Engineering and Technology*. Vol-2. Tata McGraw Hill: New Delhi, 1988.
3. Sharma, B.K. *Industrial Chemistry*, Meerut: GOEL Publishing House, 2000.
4. Acharya, N.K. *Textbook on Intellectual Property Rights*, Asia Law House, 2001.
5. Gopalakrishnan, N.S. and Agitha, T.G. *Principles of Intellectual Property*, Eastern Book Company, Lucknow, 2009.
6. Bouchoux, D.E. *Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets*, Cengage Learning, 3rd Ed., 2012.
7. Prabuddha Ganguli, *Intellectual Property Rights: Unleashing the Knowledge Economy*, McGraw Hill Education, 2011.
8. ScopleVinod, V. *Managing Intellectual Property*, Prentice Hall of India Pvt. Ltd., 2012.
9. Satakar, S.V. *Intellectual Property Rights and Copy Rights*, EssEss Publications, New Delhi, 2002.

E-Resources

1. http://www.ignou.ac.in/upload/unit-3.pdf
2. http://www.sginstitute.in/Downloads/Civil_Downloads/LectureNo_2.pdf
3. https://mycourses.aalto.fi/pluginfile.php/272892/course/section/60458/Lec06_Cement.pdf
4. https://nptel.ac.in/courses/103/107/103107086/
5. https://nzic.org.nz/app/uploads/2017/10/10D.pdf

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Discipline Specific Elective**		SEMESTER **I**
Course Title: **COMPUTER APPLICATIONS IN CHEMISTRY**		
Course Code: **33DS1B**	Hours per week: **5**	Credits: **5**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ impart knowledge and understand the various reagents, reactions and their mechanisms
- ✓ Understand conformational analysis of acyclic and cyclic organic compounds.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Outline and examine the mechanism of various nucleophilic substitution and elimination reactions	K2 & K4
CLO2	Illustrate, apply and analyze the stability of various conformations of acyclic and cyclic organic compounds	K2, K3 & K4
CLO3	Understand and apply the addition reactions of alkene, carbonyl compounds to organic synthesis	K2 & K3
CLO4	Recall, demonstrate and examine the naming reactions and their mechanisms	K1, K2 & K3
CLO5	Make use of the reagents and examine their importance in synthetic applications	K3 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	3	1	1	1	1	1	3
CLO 2	3	1	1	1	1	1	3
CLO 3	3	1	1	1	1	1	3
CLO 4	3	1	1	1	1	1	3
CLO 5	3	1	1	1	1	1	3
Weightage of the course	15	5	5	5	5	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	1	3
CLO 2	3	3	3	1	3
CLO 3	3	3	3	1	3
CLO 4	3	3	3	1	3
CLO 5	3	3	3	1	3
Weightage of the course	15	5	5	5	5

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: BASIC CONCEPTS OF PROGRAMMING IN C

Introduction to computers – character set – keywords and identifiers – constants, variables – data types – declaration of variables – assigning values to variables – defining symbolic constants.

UNIT-II: **ARRAY, FUNCTIONS AND POINTERS**

Array: Introduction – one-dimensional array and two-dimensional array – initialize an array.

Functions: Introduction – different types of functions – nesting of functions – regression – library function.

Pointers: Introduction – accessing the address of a variable – declaring and initializing pointers – accessing a variable through its pointers – pointers and array – pointers and functions.

UNIT-III: BASIC CONCEPT OF COMMUNICATION SYSTEMS

Communication system: Satellites – RADAR – optical fibers – advantages and disadvantages – ISDN – distributed systems – advantages and disadvantage.

Telecommunications: Analog digital signals – types and needs of modulation – MODEMS – telecommunication software.

Computer networks: An overview – communication processors – protocols – network architecture.

UNIT-IV: BASIC CONCEPT OF INTERNET

Internet: History of the internet – the working way of internet – getting connected to internet – internet protocols – internet addressing – domain names.

WWW: Web page – home page – web browsers – search engine – internet chat – chatting on web.

E-Mail: Introduction – working way – mailing basic – e-mail ethics – advantages and disadvantages – creating e-mail – receiving and sending e-mails.

Internet: Characterization – advantages – drawbacks – need for intranet – extranet.

UNIT-V: APPLICATIONS IN CHEMISTRY

Few selected problems – determination of molarity, molality and normality of solutions – calculation of pH – calculation of cell parameters – calculation of concentration of Beer-Lamberts law – Determination of rate constants in kinetics.

of concentration of Beer-Lamberts law – Determination of rate constants in kinetics.

Reference Books

1. Balagurusamy, E. *Programme in C*, Tata Mcgraw-Hill Publishing Company, New Delhi 2nd Ed.
2. Barbara Kasser, Using the Internet, 4th Ed., EE Ed., New Delhi, 1998.
3. Raman, K.V., *Computers in Chemistry*, Tata-McGraw Hill Publishing Company, New Delhi, 1993.
4. Alexis Leon and Mathews Leon, *Fundamentals of Information Technology*, (chapters 17 – 19 & 21 – 23), Leon Vikas, Chennai, 1998.

E-Resources

1. https://www.indianhills.edu/_myhills/courses/CSC110/documents/lu02_basics.pdf
2. http://jiwaji.edu/pdf/ecourse/microbiology/Biostatistics(basic%20concept%20of%20internet).pdf
3. https://www.guru99.com/c-function-pointers.html
4. http://www.chem.ucla.edu/dept/Faculty/dxn/teaching_resources/chem126_all_19.pdf

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **II**
Course Title: **ORGANIC CHEMISTRY - II**		
Course Code: **33CC21**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Learn and understand the basic reaction mechanism of various reactions and conformation analysis of molecule. Gain knowledge about the various naming reactions and the reagents in organic synthesis

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Recall and apply the basic reaction mechanism of various reactions	K1& K3
CLO2	Relate and compare the conformation analysis of molecule	K1, K2 & K3
CLO3	Develop and examine the reaction mechanism of addition reactions	K2 & K4
CLO4	Interpret and analyze the mechanism of various naming reactions	K2 & K4
CLO5	Define, outline and analyze the reagents in organic synthesis	K1, K2 &K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	1	3	1	1
CLO 2	9	1	3	1	3	1	1
CLO 3	9	1	3	1	3	1	1
CLO 4	9	1	3	1	3	1	1
CLO 5	9	1	3	1	3	1	1
Weightage of the course	45	5	15	5	15	5	5

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	9	1	3
CLO 2	9	9	9	1	3
CLO 3	9	9	9	1	3
CLO 4	9	9	9	1	3
CLO 5	9	9	9	3	3
Weightage of the course	45	45	45	15	15

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: REACTION MECHANISM

Substitution Reactions: Nucleophilic substitution at saturated carbon atom– S_N1, S_N2 and S_Ni reactions – mechanism and evidences – effect of structure – solvent – nucleophile and nucleofuge – stereochemistry – S_N1, S_N2, S_Ni, S_N', S_N2', S_N1cA and S_N2cA mechanism – neighbouring group participation – non classical carbocations – S_NAr mechanisms.

Elimination Reactions: E_1, E_2 and E1cB – evidences – effect of structure, solvent and base – Hoffmann and Saytzeff rules – stereochemistry of E_1 reaction – pyrolytic elimination – cis elimination – elimination *vs* substitution.

UNIT-II: CONFORMATIONAL ANALYSIS

Configuration and conformation – conformers, conformational isomers and atropisomers – conformational analysis of acyclic and cyclohexane systems – conformational free energy difference – Eliel-Ro equation – conformation and reactivity of mono- and di-substituted cyclohexanes – simple reactions illustrating torsional, steric and stereo electronic factors in acyclic and cyclohexane derivatives – Curtin-Hammett principle – conformation and reactivity of cyclohexenes and cyclohexanone – conformational analysis of decalins.

UNIT-III: ADDITIONS TO C=C AND C=O GROUPS

Electrophilic, nucleophilic and free radical addition – addition to conjugated systems – orientation of the addendum – stereochemical factors in reactions like addition of hydrogen, halogen, halides and hypohalous acids – hydroboration and hydroxylation – sharpless asymmetric epoxidation.

Addition to carbonyl groups: Mechanism – aldol condensation – Perkin reaction – Knoevenagel reaction – Mannich reation – Cannizzaro reaction – benzoin condensation – Claisen ester condensation – Darzens reaction – Reformatsky reaction – Wittig reaction – Grignard reagents.

Addition to α, β-unsaturated carbonyl groups: Michael addition – Diels-Alder reactions – addition to carbenes and carebenoids to double and triple bonds – addition to cyclopropane ring – esterfication of acids and hydrolysis of esters – decarboxylation of carboxylic acids.

UNIT-IV: SELECTIVE ORGANIC NAME REACTIONS AND THEIR MECHANISM

Ene reaction – Hofmann-Loffler-Freytag reaction – Shapiro reaction – Baeyer-Villiger reaction – Chichibabin reaction – Skraup synthesis – Fischer indole synthesis – Robinson annulation – Oppenauer oxidation – Clemmensen, Wolff-Kishner, Meerwein-Ponndorf-Verley and Birch reduction – mechanism of Stobbe and Dieckmann condensation.

UNIT-V: REAGENTS IN ORGANIC SYNTHESIS

Complex metal hydrides such as $LiAlH_4$, $NaBH_4$, $Na(CN)BH_3$, $Zn(BH_4)_2$, Gilman reagent, lithiumdimethylcuprate – lithium disopropylamide (LDA) – dicyclohexylcarbodimide 1,3 Dithiane (reactivity umpolung) – trimethylsilyl iodide – tri-n-butyltin hydride – Woodward and Prevost hydroxylation – osmium tetroxide – DDQ – selenium dioxide – phase-transfer catalysts – crown ethers and Merrifield resin – Peterson's synthesis – Wilkinson's catalyst – baker's yeast.

Reference Books

1. Sykes, P. *A Guide book to Mechanism in Organic Chemistry*, 6th Ed., Orient Longman Ltd., 1997.
2. Carey, F.A. and Sunberg, R.J. *Advanced Organic Chemistry*, Part A and Part B, Kluwer Academic/Plenum Publishers, 2004.
3. March, J. *Advanced organic Chemistry – Reactions, Mechanism and Structure*, 4th Ed., John Wiley and sons, 2007.
4. Clayden, J. Greeves, N. and Warren, S. *Organic Chemistry*, 2nd Ed., OXFORD University Press, 2014.
5. Norman, R.O.C. and Coxan, J.M. *Principles of Organic Synthesis*, 3rd Ed., Nelson Thomes, 2001.
6. Carruthers, W. and Coldham, I. *Moderns Methods of Organic Synthesis*, 4th Ed., Cambridge University Press, UK, 2004.
7. Smith, M.B. *Organic Synthesis*, 3rd Ed., Academic Press, 2011.
8. Brukner, R. *Organic Mechanisms Recation, Stereochemistry and Synthesis*, 3th Ed., Spektrum Akademischer Verlag, 2007.
9. Kalsi, P.S, *Organic Reactions Stereochemistry and Mechanisms*, 4th Ed., New Age International Pub. 2008.
10. Sanyal, S.N. *Reactions, Rearrangements and Reagents*, BharatiBhawan Pub & Dis. New Delhi, 2014.

E-Resources

1. https://www.slideshare.net/sureshss141/organic-reaction-mechanism-full
2. https://www.slideshare.net/AZCPh/strereochemistry-part-ii
3. https://www.youtube.com/watch?v=MQUFKI9HTsI
4. https://www.slideshare.net/kandarp22/organic-reactions-and-mechanisms
5. https://www.youtube.com/watch?v=CPOD_Brh5Q8

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **II**
Course Title: **INORGANIC CHEMISTRY - II**		
Course Code: **33CC22**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Learn and understand the nomenclature, isomerism, bonding, reaction mechanism, magnetic property and electronic spectra of coordination compounds.
- ✓ Gain knowledge about the basics of lanthanides and actinides.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Recall and apply the basic terminologies and concept of isomerism in coordination compounds.	K1& K3
CLO2	Relate and compare the valence band and crystal field theory and construct the molecular orbital diagrams of complexes	K1, K2 & K3
CLO3	Interpret and analyze the electronic spectra of coordination complexes	K2 & K4
CLO4	Develop and examine the reaction mechanism of coordination compounds	K2 & K4
CLO5	Define, outline and analyze the basic properties and chemistry of lanthanides and actinides	K1, K2 &K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO 1	9	1	3	1	1	1	3
CLO 2	9	1	3	1	1	1	3
CLO 3	9	1	3	1	1	1	3
CLO 4	9	1	3	1	1	1	3
CLO 5	9	1	3	1	1	1	3
Weightage of the course							

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	1	3
CLO 2	9	9	3	1	3
CLO 3	9	9	3	1	3
CLO 4	9	9	3	1	3
CLO 5	9	9	3	1	3
Weightage of the	45	45	15	5	15

course					

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: COORDINATION CHEMISTRY – I

Introduction: Types of ligands – coordination sphere, coordination number – nomenclature of mononuclear and dinuclear complexes – chelate effect – Werner's theory and Sidgwick's theory – EAN and formation of metal-metal bond in dimers – stability of complexes – determination of stability constants – Job's method – stepwise stability constant – overall stability constant – factors affecting stability of coordination compounds – charge of central metal ion – size of central metal ion – chelate ring size – steric effects.

Isomerism: Linkage, ionization, hydrate, coordination, position isomerism – geometrical (*cis* and *trans*, *fac* and *mer*) and optical isomerism.

UNIT-II: COORDINATION CHEMISTRY – II

Valence bond theory: Hybridization – geometry – magnetism – drawbacks of VBT.

Crystal field theory: Crystal field effects – assumptions of crystal field theory – crystal field splitting in octahedral and tetrahedral geometries – qualitative crystal field splitting diagrams – high-spin and low-spin complexes – factors affecting the magnitude of Δ – calculation of CFSE – spectrochemical series – Jahn-Teller theorem – crystal field splitting in tetragonally distorted octahedral geometry and in square planar geometry – applications of CFT.

Molecular orbital theory: Molecular orbital diagram of $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$.

UNIT-III: COORDINATION CHEMISTRY – III

Electronic spectra of coordination complexes – quantum numbers of multi electron atoms – microstates of electron configuration in free atoms and ions – RS coupling – spin-orbit coupling – spin multiplicity – ground state terms for p^1–p^6 and d^1 – d^{10} states – selection rules for d-d spectra – width and shapes of d-d spectra – effect of Jahn-Teller effect on the width of the spectrum.

Splitting of free ion terms in octahedral field – correlation diagram – Orgel diagrams for d^1 – d^9 ions for tetrahedral and octahedral complexes – calculation of 10Dq and assignment of transitions to the spectra of complexes: $[Fe(H_2O)_6]^{2+}$, $[Cu(H_2O)_6]^{2+}$, $[V(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{2+}$, $[CoCl_4]^{2-}$ – nephelauxetic ratio and its effect – Racah parameter – Tanabe-Sugano diagram for d^6 ion – charge transfer spectra and its types (MLCT, LMCT)

UNIT-IV: COORDINATION CHEMISTRY – IV

Labile and inert complexes – ligand substitution reactions in octahedral and square planar complexes – S_N1, S_N2 and S_N1CB mechanisms – acid hydrolysis and base hydrolysis reactions.

Trans effect – theories of trans effect – pi-bonding theory and polarization theory – applications of trans effect – cis effect.

Redox reaction – electron transfer reaction – mechanisms of inner sphere and outer sphere electron transfer reactions.

Magnetic properties of tetrahedral and octahedral complexes: Para, dia, ferromagnetism and antiferro magnetism – determination of magnetic properties – orbital contribution to a magnetic moment – spin only formula – Gouy's method.

UNIT-V: LANTHANIDES AND ACTINIDES

Lanthanides: Lanthanide series – abundance and natural isotopes – lanthanide contraction – similarity in properties, occurrence, oxidation states – chemical properties of Ln(III) cations – magnetic properties, colour and electronic spectra of lanthanide compounds – separation of lanthanides – solvent extraction, ion exchange – chemical properties of Ln(III) metal ions.

Actinides: Actinide series – abundance and natural isotopes – occurrence, preparation of actinides – oxidation states, general properties – the later actinide elements – uranium occurrence – metallurgy – chemical properties of hydrides, oxides, and halides – complexes of lanthanides and actinides.

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Reference Books

1. Huheey, J.E., Keiter, E.A. and Keiter, R.L. *Inorganic Chemistry: Principles of structure and reactivity*, 4th Ed., Pearson Education Pte. Ltd., Delhi, 2004.
2. Atkins, P.W., Overton, T.L., Rourke, J.P., Weller, M.T. and Armstrong, F.A. *Inorganic Chemistry*, 5th Ed., Oxford University Press, 2010.
3. Cotton, F. A., Wilkinson, G., Murillo, C.A. and Bochmann, M. *Advanced Inorganic Chemistry*, 6th Ed., Wiley India Pvt. Ltd., Delhi, 2015.
4. Purcell, K.F. and Kotz, J.C. *Inorganic Chemistry*, Cengage Learning India Private Limited, Delhi, 2017.
5. Meissler, G.L. and Tarr, D.A. *Inorganic Chemistry*, 3rd Ed., Pearson India Education Services Pvt. Ltd., 2015.
6. Douglas, B., McDaniel, D. and Alexandar, J. *Concepts and Models of Inorganic Chemistry*, 3rd Ed., Wiley India Pvt. Ltd., Delhi, 2015.
7. Weller, M., Overton, T., Rourke, J. and Armstrong, F. *Inorganic Chemistry*, 6th Ed., Oxford University Press, Delhi, 2015.
8. Lee, J.D., *Concise Inorganic Chemistry*, 5th Ed., Blackwell Science Ltd., 2006.
9. Puri, B.R., Sharma, L.R. and Kalia, K.C., *Principles of Inorganic Chemistry*, 33rd Ed., Vishal Publishing, 2017.
10. Malik, W.U., Tuli, G.D. and Madan, R.D., *Selected Topics in Inorganic Chemistry*, 1st Ed., S. Chand & Company Ltd., 2008.
11. Cotton, F.A., Wilkinson, G. and Gaus, P.L. *BasicInorganic Chemistry*, 3rd Ed., John Wiley, New York, 2008.
12. Greenwood, N.N. and Earnshaw, A. *Chemistry of the Elements*, 2nd Ed., Pergamon Press, Oxford, 2005.

E-Resources

1. https://nptel.ac.in/courses/104/105/104105033/
2. https://nptel.ac.in/courses/104/101/104101121/
3. https://nptel.ac.in/courses/104/106/104106064/
4. https://www.alchemyst.co.uk/pdf/Inorganic/lanthanides_and_actinides.pdf

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **II**
Course Title: **PHYSICAL CHEMISTRY - II**		
Course Code: **33CC23**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ know about the applications of quantum mechanics
- ✓ understand the principles and instrumentation of various spectroscopic techniques
- ✓ gain knowledge about surface chemistry and its role in catalysis
- ✓ understand the principles of photochemistry

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Apply and analyze the concepts of quantum mechanics	K3 & K4
CLO2	Demonstrate, organize and examine the principle and applications of microwave and IR spectroscopy	K2, K3 & K4
CLO3	Understand and apply the concepts of Raman, photo acoustic spectroscopy and photoelectron spectroscopy	K2 & K3
CLO4	Define and explain the different concepts of adsorption isotherm	K1 & K2
CLO5	Recall, illustrate and analyze the principles of photochemistry and its significance	K1, K2 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	3	3	1	3
CLO 2	9	1	3	3	3	1	3
CLO 3	9	1	3	3	3	1	3
CLO 4	9	1	3	3	3	1	3
CLO 5	9	1	3	3	3	1	3
Weightage of the course	45	5	15	15	15	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	1	1
CLO 2	9	9	3	1	1
CLO 3	9	9	3	1	1
CLO 4	9	9	3	1	1
CLO 5	9	9	3	1	1
Weightage of the course	45	45	15	5	5

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: QUANTUM MECHANICS – III

The variation method and perturbation theory, application to the helium atom – Slater orbital – self-consistent field (SCF) method – antisymmetry and exclusion principle – Slater determinatal wave functions – term symbols and spectroscopic states of atoms and diatomic molecules – Born–Oppenheimer approximation – hydrogen molecule ion – LCAO, MO and VB treatments of the hydrogen molecule – electron density, forces and their role in chemical binding – hybridization and valence MOs of H_2O, NH_3 and CH_4 – Huckel pi-electron theory and its application to ethylene, butadiene and benzene.

UNIT-II: SPECTROSCOPY – I

A: MICROWAVE SPECTROSCOPY

Classification of molecules – rigid rotor model – effect of isotopic substitution on the transition frequencies – intensities – non-rigid rotor – Stark effect – applications.

B: INFRARED SPECTROSCOPY

Review of linear harmonic oscillator – vibrational energies of diatomic molecules – zero-point energy – force constant and bond strength – anharmonicity – Morse potential energy diagram – vibration-rotation spectroscopy – P, Q, R branches – **f**ortrat diagram – breakdown of Born-Oppenheimer approximation – vibrations of polyatomic molecules – selection rules – normal modes of vibration – group frequencies – overtones – hot bands.

UNIT-III: SPECTROSCOPY – II

RAMAN SPECTROSCOPY

Classical and quantum theories of Raman effect – pure rotational, vibrational and vibrational-rotational Raman spectra – selection rules – mutual exclusion principle – Resonance Raman(RR) spectroscopy – introduction and application to [W $(CO)_4$(phen)]

i) MOLECULAR SPECTROSCOPY: Energy levels – molecular orbitals – vibronic transitions – vibrational progressions and geometry of the excited states.

ii) PHOTOELECTRON SPECTORSCOPY: Basic principles – photo electric effect – ionization process – Koopman's theorem – photo electron spectra of simple molecules – ESCA – chemical information from ESCA – Auger effect – basic idea.

iii) PHOTO ACOUSTIC SPECTROSCOPY: Basic principles of photo acoustic spectroscopy (PAS) – gases and condensed systems – chemical and surface applications.

UNIT-IV: CATALYSIS AND SURFACE CHEMISTRY

Homogeneous catalysis – acid-base catalysis – acidity function – Michaelis-Menten kinetics – fast reaction techniques – chemical relaxation methods – T-jump and p-jump methods – ultrasonic absorption techniques – reaction in a flow system – continuous and stopped flow methods.

Physisorption and chemisorption – Langmuir, BET and Gibbs adsorption isotherm – insoluble surface films – electro kinetic phenomena – zeta potential – heterogeneous catalysis – unimolecular and bimolecular reactions and their kinetics – micellar chemistry (Introduction and basic aspects).

UNIT-V: PHOTOCHEMISTRY

Photophysical response from electronically excited molecules – radiative and radiationless transitions – internal conversion and intersystem crossing – fluorescence – phosphorescence – Jablonski diagram – delayed fluorescence – life time of excited molecules – quenching proess – Stern-Volmer equation – principles of energy transfer – spin-orbit coupling – eximers and exciplexes – properties of excited states – excited state acidity constant – Kasha's tests for identification of $n\rightarrow\pi^*$ and $\pi\rightarrow\pi^*$ transitions – applications of photochemistry –photosynthesis – solar energy conversions and storage – photochemical fast reactions – flash photolysis technique.

Reference Books

1. Puri, B.R. Sharma L.R and Pathania, M.S. *Principles of Physical Chemistry*, 46th Ed., Vishal Publishing Co., 2014.
2. Prasad, R.K., *Quantum chemistry*, 4th Ed., New Age International (P) Ltd., Publishers, 2010.
3. McQuarrie, D.A. *Quantum Chemistry*, 2nd Ed., University Science Books, California, 2008.
4. Atkins, P.W. and Friedman. R., *Molecular Quantum Mechanics,* 5th Ed., Oxford university Press, 2011.
5. Banwell, C.N. and McCash, E.M. *Fundamentals of Molecular Spectroscopy*, 4th Ed.,Tata McGraw Hill, New Delhi, 2008.
6. Atkins, P. and de Paula, J. *Physical Chemistry,* 7th Ed., Oxford University Press, Oxford, 2002.
7. Rohatgi–Mukheriji, K.K. *Fundamentals of Photochemistry*, Wiley-Eastern.- 2000.
8. Chandra, A.K. *Introductory quantum Chemistry* – 4th Ed., Tata-McGraw Hill publishing Co.Ltd. New Delhi. – 1996
9. Sen, B.K, *Quantum Chemistry*, Tata McGraw Hill Co. Ltd., New Delhi, 1992.
10. Maron, S.H. and Prutton, C.M. *Principle of physical Chemistry*, 4th Ed, Oxford and IBH Pub. Pvt. Ltd. New Delhi. 1976.
11. Prasad, R.K. *Quantum Chemistry*, 3rd Ed., Wiley Eastern, 2000.
12. Cotton, F.A. *Chemical application of group theory*, 2nd Ed., Wiley Eastern Ltd., 1997.
13. Cox. and Camp, T. *Introductory photoChemistry*, McGraw-Hill publishing Co.Ltd. New Delhi, 1996.
14. Drago, R.S. *Physical methods in Chemistry*, Sainderscollege, 1987.
15. Barrow, G.M. *Introduction to molecular spectroscopy*, MC Graw Hill publishing Co. Ltd. New Delhi, 1994.
16. Chang, R. *Basic Principles of spectro*scopy, Mc Graw Hill publishing Co.Ltd. New Delhi, 1992.

E-Resources

1. https://nptel.ac.in/courses/122/106/122106034/
2. https://nptel.ac.in/courses/115/101/115101107/

3. https://nptel.ac.in/courses/115/104/115104096/
4. https://nptel.ac.in/content/storage2/courses/115106057/STiAP_Unit_4_Hartree_Fock_L19_to_L23.pdf
5. https://nptel.ac.in/content/storage2/courses/115101003/downloads/module2/lecture12.pdf

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Practical**		SEMESTER **II**
Course Title: **ORGANIC PREPARATION AND QUANTITATIVE ESTIMATION**		
Course Code: **33CP24**	Hours per week: **5**	Credits: **4**
CIA Marks: **40 Marks**	ESE Marks: **60 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ develop analytical skill in organic quantitative estimation
- ✓ impart the skills in organic preparation

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

CLO Number	CO Statement	Knowledge Level
CLO 1	Estimate and analyze the organic compounds	K4
CLO5	Make use of lab skill in the preparation of organic compounds	K3
CLO 3	Demonstrate the recrystallization of organic compounds	K2
CLO 4	Demonstrate the estimation of alcohol ,amine and Ketone	K2
CLO5	Demonstrate the estimation of Carbohydrate and amino acid	K2

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Syllabus

I. Organic Quantitative Estimation

UNIT-I

1. Estimation of phenol
2. Estimation of aniline

UNIT-II

1. Estimation of ethyl methyl ketone
2. Estimation of glucose
3. Estimation of glycine

II. Organic Preparation involving two stages

UNIT-III

1. *Sym*–tribromobenzene from aniline.
2. *meta*–nitrobenzoic acid from methyl benzoate.

UNIT-IV

1. *para* – nitroaniline from acetanilide.
2. benzanilide from benzophenone.

UNIT-V

1. anthraquinone from phthalic anhydride.
2. *para* – bromoaniline from acetanilide

Reference Books

1. Gnanapragasam, N.S. and Ramamuthy, G. *Organic Chemistry – lab manual*, S.Viswanatahan Co.Pvt. Ltd., 1998.
2. Vishnoi, N.K. *AdvancedPractical Organic Chemistry*, Vikas Publishing House Pvt. Ltd., 1982.
3. Vogel. A.I. *Vogel's Textbook of Practical Organic Chemistry*, 4th Ed., Longmann group, 2008.

4. LAB MANUAL - Prepared by Faculty, Department of Chemistry, Vivekananda College.

E-Resources

1. https://www.youtube.com/watch?v=hZiWD2nLanI
2. https://www.youtube.com/watch?v=_GKfdRfoPnY
3. https://www.youtube.com/watch?v=mQ035ZrdD4Y
4. https://www.youtube.com/watch?v=sqIhKvAO9j4
5. https://www.youtube.com/watch?v=wMyP_bJ4MrQ

Distribution of marks

Max marks: 100

Internal	**: 40 marks**	**External**	**: 60 marks**
Attendance	: 5 marks	Experiment	: 30 marks
Laboratory performance		Simple procedure	: 10 marks
and model practical	: 20 marks	Record note book	: 10 marks
Viva-voce	: 5 marks	Viva-voce	: 10 marks
Observation note book	: 10 marks		
Total	: 40 marks	Total	: 60 marks

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Practical**		SEMESTER **II**
Course Title: **PRACTICAL PHYSICAL CHEMISTRY**		
Course Code: **33CP25**	Hours per week: **5**	Credits: **4**
CIA Marks: **40 Marks**	ESE Marks: **60 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ understand the principle of thermochemistry, chemical kinetics, potentiometric and conductometric titrations.
- ✓ gain knowledge about the phase transformations of different systems.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the enthalpy of solubility of solution	K2
CLO2	Examine the strength of the solutions and K_a values by kinetic methods	K4
CLO3	Analyse the molecular weight of chemical compounds from K_f values by Rast micro method	K4
CLO4	Demonstrate and analyze Phase diagrams	K2 & K4
CLO5	Understand and analyse the conductometric and potentiometric titration	K2 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Syllabus

UNIT-I

Basic concepts of volumetric titration, thermochemistry, surface chemistry, colligative properties, phase rule, electrochemistry and chemical kinetics

UNIT-II

1. Thermochemistry – enthalpy of solution by solubility method – unknown concentration.
2. Rast micro method – determination of K_f and molecular weight by micro method.
3. Adsorption of acetic acid/oxalic acid on activated charcoal – Freundlich adsorption isotherm – determination of unknown concentration.

UNIT-III

4. Viscosity – variation of viscosity of liquids with temperature
5. Three component liquid systems: acetic acid, benzene and water
6. Activation energy for the acid-catalyzed hydrolysis of ethyl acetate.

UNIT-IV: COUNDUCTIVITY EXPERIMENTS

7. Determination of cell constant
8. Determination of relative strength of two acids by conductance measurements. (acid *vs.* base strong acid, weak acid strong base and mixture of acid)
9. Conductometric displacement titration (NH_4Cl Vs NaOH)
10. Determination of λ_a for acetic acid using Kholrausch's law.
11. Saponification of ester followed by counductometric method solubility products of sparingly soluble salts.

UNIT-V: POTENTIOMETRIC EXPERIMENTS

12. Potentiometric acid -base titration
13. Measurnment of standard electrode potential
14. Determination of pH using quinhydrone electrode
15. Potentiometeric redox titration (KI Vs $KMnO_4$ Vs KI)
16. Determination of dissociation constant of weak acids by potentiometry.

Reference Books

1. Thomas, A.O. *Text Book of Practical Chemistry* Scientific Publication, 4th Revised Edition, 1976.
2. Viswanathan, B. and Raghavan, P.S. *Practical Physical Chemistry Viva Books*, 3rd Ed., 2009.
3. Levitt, B.P. *Findlay's Practical Physical Chemistry*, 9thEd., Longman Publications,1973.
4. Palmer, G. *Experimental Physical Chemistry*, 1st Ed., Cambridge University Press, 1964.
5. Yadav, J. B., *Advanced Practical Physical Chemistry*, 22nd Ed., GOEL publishing House, Krishna Prakashan Media Ltd, 2005.
6. Venkatesan, V., Veeraswamy, R. and Kulandaivelu, A.R. *Basic Principles of Practical Chemistry*, 2nd Ed., Sultan Chand and Sons Publication, New Delhi, 1997.
7. Levitt, B.P. Findlay's *Practical Physical Chemistry*, 9th Ed., Longman, London, 1985.
8. Lab Manual-*Prepared by Faculty*, Department of Chemistry, Vivekananda College

E-Resources

1. https://www.youtube.com/watch?v=RR3ys87p9aA
2. https://www.youtube.com/watch?v=2VzEpsEZOYo
3. https://www.youtube.com/watch?v=tOGdZFDU2eU
4. https://www.youtube.com/watch?v=8jp_wlQcE3Y
5. https://www.youtube.com/watch?v=WwjFwNhmhZ0

Distribution of marks

Max marks: 100

Internal	**: 40 marks**	**External**	**: 60 marks**
Attendance	: 5 marks	Experiment	: 30 marks
Laboratory performance		Simple procedure	: 10 marks
and model practical	: 20 marks	Record note book	: 10 marks
Viva-voce	: 5 marks	Viva-voce	: 10 marks
Observation note book	: 10 marks		
Total	: 40 marks	Total	: 60 marks

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Elective Theory**		SEMESTER **II**
Course Title: **MEDICINAL AND PHARMACEUTICAL CHEMISTRY**		
Course Code: **33DS2A**	Hours per week: **5**	Credits: **5**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Learn the medicinal values of various drugs, its actions and metabolism of drugs.
- ✓ Gain basic knowledge about common diseases and their treatments.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Define and classify the terminologies of pharmaceutics	K1 & K2
CLO2	Select, choose and distinguish the uses of various medicinal herbs	K1, K3 & K4
CLO3	Summarize and distinguish the different types of drugs and their functions	K2 & K4
CLO4	Demonstrate and categorize the common body ailments in pharmaceutics	K2 & K4
CLO5	Describe and analyze the various therapeutic agents for good health	K2 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	3	3	1	3
CLO 2	9	1	3	3	3	1	3
CLO 3	9	1	3	3	3	1	3
CLO 4	9	1	3	3	3	1	3
CLO 5	9	1	3	3	3	9	3
Weightage of the course	45	5	15	15	15	13	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	3	3	1	3
CLO 2	9	3	3	1	3
CLO 3	9	3	3	1	3
CLO 4	9	3	3	1	3
CLO 5	9	3	3	1	3
Weightage of the course	45	15	15	5	15

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: INTRODUCTION

Common diseases – infective disease – Insect-borne, air-borne and water-borne – hereditary disease terminology – drug, pharmacology, pharmacognesy, pharmacodynamics, pharmacokinetics, antimetabolites – absorption of drugs – routes of administration of drugs – factors affecting absorption – assay of drugs – chemical, biological, immunological assays – LD_{50} and ED_{50} therapeutic index – drug dosage – drug analysis and design of drugs.

UNIT-II: **DRUGS AND THEIR FUNCTIONS**

Various source of drugs – pharmacologically active constituents in plants – Indian medicinal plants – tulsi, neem, keezhanelli – their importance – classification of drugs – biological and chemical – mechanism of drug action – action at cellular and extra cellular sites – drug receptor and biological responses – metabolism of drug through oxidation, reduction, hydrolysis and conjugate processes – factors affecting metabolism.

UNIT-III: **CHEMOTHERAPY**

Designation of drug based on physiological action – definition and two examples each of anaesthetic – general and local analgesics – narcotic and synthetic – antipyretics and anti- inflammatory agents – antibiotics – penicillin, streptomycin, chloramphenicol, tetracyclins-antivirals, AIDS-symptoms, prevention, treatment – cancer and neoplastic agents.

UNIT-IV: **COMMON BODY AILMENTS**

Diabetes – causes, hyper and hypoglycemic drugs – blood pressure – systolic & diastolic –hypertensive drugs – cardiovascular drugs – antiarrhythmic, antianginals, vasodilators – CNS depressants and stimulants – Psychedelic drugs, hypnotics, sedatives (barbiturates, LSD) – lipid profile – HDL, LDL cholesterol – lipid lowering drugs.

UNIT-V: HEALTH PROMOTING DRUGS

Nutraceuticals – vitamins A, B, C, D, E and K – micronutrients Na, K, Ca, Cu, Zn, I – medicinally important inorganic compounds of Al, P, As, Hg and Fe – examples for each, their role and applications – organic pharmaceutical acids – agents for kidney function (aminohippuric acid) – agents for liver function (sulfobromophthalein) – agents for pituitary function (metyrapone) – organic pharmaceutical bases – antioxidants, treatment of ulcer and skin diseases.

Reference Books

1. Jayashree Ghosh, *Pharmaceutical Chemistry*, S. Chand and Company Ltd., New Delhi, 2006.
2. Lakshmi S, *Pharmaceutical Chemistry*, S. Chand & Sons, New Delhi, 1995.
3. Ashutoshkar, *Medicinal Chemistry*, Wiley Eastern Ltd., New Delhi. 1993.
4. William, D. and Lemke, T. *Foye's Principles of Medicinal Chemistry*, BlPublisher.,5th Ed., 2000.
5. Kadam. S.S., Mahadik, K.R. and Bothara, K.G. *Principles of Medicinal Chemistry*, Vol. II NiraliPrakashan, Pune.
6. Craig, C.R. and.Stitzel, R.E. *Modern Pharmacology with Clinical Applications*, 6th Ed., Lippincott Williams and Wilkins, New York, 1992.
7. Patrick, G. L. *Introduction to Medicinal Chemistry*, Oxford University Press, UK, 2013.

E-Resources

1. https://onlinecourses.nptel.ac.in/noc20_cy16/preview
2. https://jcpjaipur.com/wp-content/uploads/2020/05/Medicinal-Chemistry-Unit-I.pdf
3. https://jcpjaipur.com/wp-content/uploads/2020/05/Medicinal-Chemistry-Unit-IV.pdf
4. https://jcpjaipur.com/wp-content/uploads/2020/07/Medicinal-Chemistry-Unit-V.pdf
5. https://www.fpharm.uniba.sk/uploads/media/Seminar_1_from_Pharmaceutical_chemistry_I_02.pdf

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Elective Theory**		SEMESTER **II**
Course Title: **BIOCHEMISTRY**		
Course Code: **33DS2B**	Hours per week: **5**	Credits: **5**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Gain an idea about the various biochemical processes
- ✓ Understand about the DNA information, storage and expression of genetic information.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	List, classify and outline the different types of enzymes and co-enzymes	K1, K2 & K3
CLO2	Demonstrate and construct the generation and storage of metabolic energy	K2 & K3
CLO3	Summarize and apply the concept of information, storage and expression of genetic information	K2 & K3
CLO4	Relate, apply and analyze the structure of DNA and other important metalloproteins	K1, K3 & K4
CLO5	Interpret, organize and examine the biochemical aspects of biochemical processes	K2, K3 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Syllabus

UNIT-I: ENZYMES AND CO-ENZYME

Classification – nomenclature – properties of enzymes – some features of active sites of enzymes – enzyme kinetics – Michaelis-Menten model – significance of Km and V_{max} values – enzyme inhibition – competitive and non-competitive – allosteric interaction – mechanism of enzyme action – lysozyme and carboxypeptidase – NAD, NADH, $NADH^{+}$.

UNIT-II: GENERATION AND STORAGE OF METABOLIC ENERGY

Metabolism – basic concepts and design – glycolysis – citric acid cycle – oxidative phosphorylation – pentose pathway and gluconeogenesis – glycogen and disaccharide metabolism – fatty acid metabolism – amino acid degradation and urea cycle – photosynthesis.

UNIT-III: INFORMATION, STORAGE, TRANSMISSION, EXPRESSION OF GENETIC INFORMATION

DNA – genetic role structure and replication – messenger RNA – transcription genetic code and gene protein relationship – protein synthesis – control of gene expression – eukaryotic chromosomes – recombinant DNA technology and viruses.

UNIT-IV: BIO-INORGANIC CHEMISTRY

Metalloproteins and enzymes – blue copper proteins – copper proteins as oxidases/reductases – nickel containing enzymes – structure of DNA – types of nucleic acid interactions – co-ordination, intercalation

and hydrogen bonding – interactions of metal ions with nucleic acid – redox chemistry, hydrolytic chemistry – monitoring the DNA binding by UV, IR, NMR and CV spectral techniques.

UNIT-V: BIOPHYSICAL ASPECTS

Electron transport and oxidative phosphorylation – thermodynamic and kinetic aspects –photosynthesis – an overview – photosystem II – the light harvesting chlorophyll – protein complexes of photosystem II – role of carotenoids in photosynthesis – the primary electron donor of photosystem II, P680 – the stable primary electron acceptor QA and the secondary electron acceptor QB – the transient intermediate electron acceptor of photosystem II, pheophytin – oxygen evolution – the role of manganese – the electron donor to $P680^{+}$ – charge recombination in photosystem II – photosystem I – light – harvesting chlorophyll-II – protein complexes of photosystem I – the primary electron donor of photosystem I, P700 – the primary electron acceptor Ao of photosystem I – the intermediate electron acceptor A1 of photosystem I – mobile electron carriers – plastocyanin and ferredoxin and $NADP^{+}$ – reductase.

Reference Books

1. Hames, B.D. and Hooper, N.M. *Biochemistry*, Viva Books Pvt. Ltd., 2003.
2. Berg, J.M., Tymoczko J.L and Stryer, L. *Biochemistry*, 5th Ed., W.H.Freman and company, New York, 2002.
3. Bertini, I., Gray, H.B., Leppard S.F., and Valentine, J.S., *Bioinorganic Chemistry*, Viva Books Pvt. Ltd., 1998.
4. Chatwal, GR. and Bhagi, AK. *Bioinorganic Chemistry*, Himalaya Publishing House, 2010.
5. Ke, B. *Advances in Photosysthesis*, Vol.10 Photosynthesis – Photobiochemistry andPhotobiophysics, Kluwer Academic Publishers, Dordrecht, 2001.

E-Resources

1. https://www.easybiologyclass.com/topic-biochemistry/
2. https://www.chem.purdue.edu/courses/chm333/
3. https://teachmephysiology.com/biochemistry/cell-growth-death/dna-replication/
4. https://www.livescience.com/51720-photosynthesis.html
5. http://cronus.uwindsor.ca/units/biochem/web/biochemi.nsf/18e8732806421826852569830050331b/7a371e9af805f74e85256a4f00538021/$FILE/Energy+metabolism.pdf

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **III**
Course Title: **ORGANIC CHEMISTRY - III**		
Course Code: **33CC31**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Understand the principle and applications of UV-Vis, IR, NMR and Mass spectrometry.
- ✓ Explain the basic principle of pericyclic reactions.
- ✓ Have knowledge on photochemical reactions.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Define, outline, apply and examine the principle and applications of UV and IR spectra to organic molecules	K1, K2, K3 & K4
CLO2	Define the terminology and explain, utilize and analyze the principle of NMR to organic compounds	K1, K2, K3 & K4
CLO3	Define the principle and illustrate, apply and analyze the applications of mass spectra to organic compounds	K1, K2, K3 & K4
CLO4	Relate, explain, apply and analyze the orbital symmetry concept to pericylic reactions	K1, K2, K3& K4
CLO5	Illustrate, apply and analyze the mechanism of photochemical reactions	K2, K3 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	1	1	1	3
CLO 2	9	1	3	1	1	1	3
CLO 3	9	1	3	1	1	1	3
CLO 4	9	1	3	1	1	1	3
CLO 5	9	1	3	1	1	9	3
Weightage of the course	45	5	15	5	5	13	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	1	3
CLO 2	9	9	3	1	3
CLO 3	9	9	3	1	3
CLO 4	9	9	3	1	3
CLO 5	9	9	3	1	3
Weightage of the course	45	45	15	5	15

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: UV-VISIBLE AND IR SPECTROSCOPY

UV-VISIBLE SPECTROSCOPY: Brief introduction – types of electronic transitions – intensity of bands – calculation of λ_{max} for dienes and dienones (Woodward-Fieser rule) – effect of solvent and pH on the absorption maxima of molecules – stereochemical factors in electronic spectroscopy – UV-Vis spectra of aromatic and heterocyclic compounds.

IR SPECTROSCOPY: Introduction **–** finger print region – identification of functional groups and interpretation of IR spectra – factors (hydrogen bonding, electronic effects, mass effects, conjugation and ring strain) influencing vibrational frequencies – inter and intra molecular hydrogen bonding.

UNIT-II: NMR SPECTROCOPY

Introduction **–** chemical shift – factors influencing chemical shift – chemical and magnetic equivalence – spin-spin coupling – vicinal and germinal coupling – coupling constants – Karplus equation – proton-deuterium exchange phenomenon – first order and non-first order spectra – simplification of complex spectra using double resonance techniques – shift reagents and increased field strength – nuclear overhauser effect (NOE) – applications of NMR to compounds such as ethanol, acetaldehyde, toluene, 1,1,2-trichloroethane, cinnamic acid, ethyl acetate, furfuraldehyde and α-chloro propinonic acid – ^{13}C NMR – basic principles – off resonance and broad band decoupling techniques – γ-gauche effect.

2D NMR: ^{1}H-^{1}H correlation spectroscopy (COSY) – ^{1}H-^{13}C COSY and nuclear overhauser effect spectroscopy (NOSEY).

UNIT-III: MASS SPECTROMETRY

Basic principles – ionization techniques (electronic ionization and chemical ionization) – fragmentation processes of organic molecules – molecular ion peak – base peak – metastable peak – isotopic peak – nitrogen rule – McLafferty rearrangement – Retro-Diels-Alder rearrangement – interpretation of mass spectra of simple organic compounds such as acetone, ethyl bromide, ethyl acetate, ethylamine, cyclohexanol, toluene, anisole, benzaldehyde, acetophenone and aniline – combined problems based on UV, IR, NMR and mass for simple molecules.

UNIT-IV: PERICYCLIC REACTIONS

Pericyclic Reactions: General characteristics – molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene and 1,3,5-hexatriene.

Electrocyclic reactions: Woodward-Hoffmann selection rules, correlation diagram approach of cyclobutene to 1,3-butadiene system – Frontier Molecular Orbital (FMO) approach of 1,3,5-trienes to cyclohexadiene system.

Cycloadditions: Woodward-Hoffmann rules, antarafacial and suprafacial additions, [2+2] and [4+2]-cycloaddition – correlation and FMO approach of ethylene to cyclobutene system – 1,3- dipolar addition – cheletropic reactions.

Sigmatropic Rearrangements: Woodward-Hoffmann rules, [1,3], [1,5] and [1,7]-sigmatropic rearrangements – Cope, oxy-Cope, aza-Cope and Claisen rearrangements.

UNIT-V: PHOTOCHEMISTRY

Photochemistry of 48 alkenes – cis-trans isomerisation – photochemistry of dienes – photosensitization – photochemical reactions of ketones – Norrish type I and type II reactions – Paterno-Buchi reaction – dienone photochemistry – photoreduction, photochemical oxidation – Barton reaction – di-pi methane rearrangements – photochemical rearrangements – photochemistry of α and β-unsaturated carbonyl compounds – photochemistry of aromatics

REFERENCE BOOKS

1. Silverstein, R.M, Bassler, G.C, and Morrill, T.C, *Spectrometric Identification of Organic Compounds*, 8th Ed., John Wiley, 1986.
2. Kemp, W, *Organic Spectroscopy*, 3rd Ed., McMillan, 1986.
3. Jag Mohan, *Organic Spectroscopy: Principles and Applications*, 2nd Ed., Alpha Science, 2004.
4. Pavia, D.L, Lampman, G.M, and Kriz, G.A, *Introduction to Spectroscopy*, 4th Ed., Cengage Learning, 2009.
5. Kalsi, P.S, *Spectroscopy of Organic Compounds*, 6th Ed., New Age International, 2004.
6. Macomber, R.S, *A Complete Introduction to Modern NMR Spectroscopy*, Wiley, 1998.
7. Mukheriji, S.M. and Singh, S.P, *Reaction Mechanism in Organic Chemistry*, 3rd Ed., Macmillan India Ltd, 1998.
8. Arora, M.G, *Organic Photochemistry and Pericyclic Reactions*, 1st Ed., Anmol Publications Pvt Ltd., New Delhi, 2004.
9. Kar, R.K, *Frontier Orbital and Symmetry Controlled Pericyclic Reactions*, 1st Ed., Books and Allied Publisher, 2010.
10. Jagdamba Singh, and Jaya Singh, *Photochemistry and Pericyclic Reactions*, 3rd Ed., New Age International Publishers Ltd., New Delhi, 2012.

    Turro, N.J, Ramamurthy, V, and Scaiano, J.C, Modern Molecular Photochemistry, University Science Books, 2010.

E-Resources

1. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
2. https://nptel.ac.in/courses/104/108/104108078/
3. https://nptel.ac.in/content/storage2/courses/104106075/Week4/MODULE%2017.pdf
4. https://nptel.ac.in/courses/104/106/104106077/
5 .http://www.nptelvideos.in/2012/11/organic-photochemistry-and-pericyclic.html

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **III**
Course Title: **INORGANIC CHEMISTRY - III**		
Course Code: **33CC32**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Understand the structure, bonding, reaction mechanism and applications of organometallic compounds
- ✓ understand the key role of various elements in the living systems.
- ✓ acquire basic knowledge about the structure and functions of certain metallo-enzymes.

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Describe and classify the organometallic compounds. Count the 18 electron of the complexes. Interpret the bonding and reactions of metal carbonyls and metal nitrosyls	K1, K2, K3 & K4
CLO2	Discuss and illustrate the basics of organometallic compounds of carbene, carbyne, alkene, alkyne and metallocene. Calculate metal metal bond in metal clusters	K1, K2, K3 & K4
CLO 3	Demonstrate and examine the applications of organometallic compounds in catalysis and coupling reactions.	K2 & K4
CLO 4	List and interpret the role of metal ions in biological systems, functions and deficiency	K1 & K2
CLO 5	Define, explain and understand the key functions of hemerythrin, hemocyanin, cytochromes, iron sulfur proteins etc and metals in medicine	K1, K2 & K3

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	1	3	1	3
CLO 2	9	1	3	1	3	1	3
CLO 3	9	1	3	1	3	1	3
CLO 4	9	1	3	1	3	1	3
CLO 5	9	1	3	1	3	1	3
Weightage of the course	45	5	15	5	15	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	1	1
CLO 2	9	9	3	1	1
CLO 3	9	9	3	1	1
CLO 4	9	9	3	1	1
CLO 5	9	9	3	1	1
Weightage of the course	45	45	15	5	5

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: ORGANOMETALLIC CHEMISTRY – I

Introduction – classification of organometallic compounds based on the nature of metal-carbon bond – classification of ligands based on hapticity – electron count in complexes: eighteen electron rule and sixteen electron rule.

Metal carbonyl: Classification of metal carbonyl – bonding in metal carbonyls – evidence for synergistic bonding (π-back bonding) – factors affecting the magnitude of stretching frequency – bonding modes of CO – number and intensity of infrared bands – preparation, properties and structure of nickel tetracarbonyl, iron pentacarbonyl, chromium hexacarbonyl and dicobaltoctacarbonyl.

Metal nitrosyl: Structure and nature of M-NO bonding in nitrosyls – preparation, properties and structure of sodium nitroprusside.

UNIT-II: ORGANOMETALLIC CHEMISTRY – II

Metal carbenes: Fischer carbenes, Schrock carbenes – Tebbe's reagent – comparison between Fischer carbenes and Schrock carbenes – metal carbynes complexes – metal alkene complexes – metal alkyne complexes – metal allyl complexes and its synthesis – buta-1,3-diene complexes – Davies-Green-Mingos (DGM) rule.

Metallocene: Definition and examples – preparation, properties, structure and bonding of ferrocene.

Cluster compounds: Metal carbonyl clusters – calculation of number of M-M bonds in low nuclearity carbonyl clusters (LNCC) – electron counting schemes for high nuclearity carbonyl clusters – the isolobal analogy.

UNIT-III: ORGANOMETALLIC CHEMISTRY – III

Oxidative addition reactions – mechanisms for oxidative addition reaction (concerted, S_N2 & radical reactions and ionic mechanisms) – reductive elimination reactions – migratory insertion reaction and its mechanism – insertion of alkenes – β-H elimination and α-H abstraction reactions.

Catalysis: Mechanisms of Wilkinson's catalytic process – hydroformylation or oxo process – Wacker process – Ziegler-Natta catalytic process – Monsanto acetic acid process – olefin metathesis – Fischer-Tropsch process and synthetic gasoline process.
Coupling reactions: Mechanism of Tsuji-Trost reaction – Heck reaction and Suzuki–Miyaura coupling.

UNIT-IV: BIO-INORGANIC CHEMISTRY – I

Essential and trace elements: Role of metal ions in biological systems – functions and deficiency symptoms of zinc, copper, cobalt, iron.

Metalloporphyrins: Role of iron in living system – structural features, functions and physiology of hemoglobin and myoglobin – co-operativity effect – Bohr Effect – Hill's constant – poisoning effect of CO and CN^- on hemoglobin.

Metalloenzyme: Carboxy peptidase – carbonic anhydrase – superoxide dismutase

UNIT-V: BIO-INORGANIC CHEMISTRY – II

Structure and functions of hemerythrin and hemocycnin – cytochromes – cytochrome P-450 – iron-sulphur proteins: ruberodoxin and ferredoxins – blue copper protein – iron storage and transport: ferritin and transferrin – nitrogen fixation – structure and functions of cholorophyll – photosynthesis (photosystem I and II) – structure and functions of vitamin B_{12} – metals in medicine.

Reference Books

1. Gupta, B.D. and Elias, A.J. *Basic Organometallic Chemistry: Concepts, Synthesis and Applications*, 2nd Ed., University Press (India) Pvt Ltd, Hyderabad, 2013.
2. Crabtree, R.H. *The Organometallic Chemistry of the Transition Metals*, 3rd Ed., John Wiley & Sons, Inc. 2001.
3. Mehrotra, R.C. and Singh, A. *Organometallic Chemistry-A Unified Approach*, 2nd Ed., New age international publications, New Delhi, 2000.
4. Huheey, J.E., Keiter, E.A. and Keiter, R.L. *Inorganic Chemistry: Principles of structure and reactivity*, 4th Ed., Pearson Education Pte. Ltd., Delhi, 2004.
5. Atkins, P.W., Overton, T.L., Rourke, J.P., Weller, M.T. and Armstrong, F.A. *Inorganic Chemistry*, 5th Ed., Oxford University Press, 2010.
6. Cotton, F.A., Wilkinson, G., Murillo, C.A. and Bochmann, M. *Advanced Inorganic Chemistry*, 6th Ed., Wiley India Pvt. Ltd., Delhi, 2015.
7. Purcell, K.F. and Kotz, J.C., *Inorganic Chemistry*, Cengage Learning India Private Limited, Delhi, 2017.
8. Meissler, G.L. and Tarr, D.A. *Inorganic Chemistry*, 3rd Ed., Pearson India Education Services Pvt. Ltd., 2015.
9. Douglas, B., McDaniel, D. and Alexandar, J., *Concepts and Models of Inorganic Chemistry*, 3rd Ed., Wiley India Pvt. Ltd., Delhi, 2015.
10. Malik, W.U., Tuli, G.D. and Madan, R.D. *Selected Topics in Inorganic Chemistry*, 1st Ed., S. Chand & Company Ltd., 2008.

E-Resources

1. https://nptel.ac.in/courses/104/101/104101079/
2. https://nptel.ac.in/courses/104/108/104108062/
3. https://nptel.ac.in/courses/104/101/104101123/
4. https://nptel.ac.in/courses/104/101/104101100/
5. https://nptel.ac.in/courses/104/101/104101121/

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **III**
Course Title: **PHYSICAL CHEMISTRY - III**		
Course Code: **33CC33**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ obtain the knowledge on chemical applications of group theory
- ✓ acquire knowledge about multiplication table for point groups
- ✓ understand the principles, instrumentation and determine the structure of unknown compounds by spectral analysis
- ✓ provide physical explanations for the ways in which important biological systems function

Course learning Outcomes (CLO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Name and explain point groups and symmetry elements of molecules	K1 & K2
CLO2	Construct and inspect the character table for point groups	K3 & K4
CLO 3	Outline, apply and examine the g-factor, nuclear spin, and hyperfine coupling constant with structure of the complexes	K2, K3 & K4
CO 4	Demonstrate and examine the internal structure of matter by ESR, NQR and Mössbauer spectroscopy	K2 & K4
CLO5	Summarize and simplify of biophysical phenomena	K3 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	3	3	1	3
CLO 2	9	1	3	3	3	1	3
CLO 3	9	1	3	3	3	1	3
CLO 4	9	1	3	3	3	1	3
CLO 5	9	1	3	3	3	1	3
Weightage of the course	45	5	15	15	15	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	3	3
CLO 2	9	9	3	3	3
CLO 3	3	3	3	9	3
CLO 4	3	3	3	9	3
CLO 5	9	9	3	9	3
Weightage of the course	33	33	15	33	15

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: GROUP THEORY – I

Symmetry elements and symmetry operation – point groups – symmetry number from point groups – matrix representation of symmetry operations – reducible and irreducible representations – great orthogonality theorem – character tables and their constructions – C_{2v}, C_{3v}, C_{2h} point groups.

UNIT-II: GROUP THEORY-II

Application of group theory to normal mode analysis – symmetry selection rules for IR and Raman active fundamentals – symmetry of molecular orbitals – symmetry selection rules for electronic transitions for simple molecules (ethylene, formaldehyde and benzene) – projection operators – SALC procedure – evaluation of energies and HMO's for ethylene and butadiene – application of group theory to solve hybridization problems (sp^2 and sp^3).

UNIT-III: NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Introduction – nuclear spin – relaxation processes – shielding and deshielding of magnetic nuclei – chemical shift and its measurements – spin-spin interactions – spin decoupling – selective decoupling – spin tickling – Nuclear Overhauser Effect (NOE) – NMR studies of nuclei other than proton – ^{13}C NMR – advantages of FT NMR.

UNIT-IV: ESR, NQR and MÖSSBAUER SPECTROSCOPY

ELECTRON SPIN RESONANCE SPECTROSCOPY

Basic principles – zero field splitting – Kramers degeneracy – factors affecting the 'g' value – anisotropy in 'g' – hyperfine coupling constants – applications.

NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY

Basic principles – quadrupole nuclei – quadrupole moments – electric field gradient – coupling constant – splitting – applications.

MÖSSBAUER SPECTROSCOPY

Basic principles – Mössbauer effect – Doppler effect – isomer shift – quadrupole splitting – magnetic hyperfine splitting – applications.

UNIT-V: BIOPHYSICAL CHEMISTRY

Buffers: Buffers and their action – Henderson-Hasselbalch equation – buffer capacity – buffering of blood.
Viscosity: Definition – significance of viscosity in biological systems – nature of blood flow through different vessels – plot of apparent viscosity of erythrocytes in physiological saline against haematocrit – amoeboid movement.
Surface tension: Definition – role of pulmonary surfactant – stability of alveoli – interfacial tension and Danielli-Davson model.
Isotopes in biology: Tracer technique – meaning – general tracer requirements – advantages of tracer experiments – limitations of tracer experiments – clinical applications.

Reference Books

1. Cotton, F.A. *Chemical application of group theory*, 2nd Ed., Wiley Eastern Ltd.,1997.
2. Raman, K.V. *Group theory and its application to chemistry*, Tata McGrawHill, Comp. Ltd., New Delhi, 1990.
3. Ramakrishnan and Gopinathan, *Group theroy in chemistry*, Vishal Publications.1998.
4. Bhattacharya, B.K. *Group theory and its chemical applications,* Himalayan Publishing House, 1990.
5. Colin N.Banwell, *Fundamentls of Molecular Spectroscopy* , Tata Mc Graw Hill Comp. Ltd., New Delhi, 1997.
6. Drago, R.S. *Physical methods in Chemistry*, Sainders College, 1987.
7. Barrow, G.M. *Introduction to molecular spectroscopy*, MC Graw Hill publishing Co.Ltd. New Delhi, 1994.
8. Chang, R. *Basic Principles of spectroscopy*, Mc Graw Hill publishing Co.Ltd. New Delhi, 1992.
9. Upadhyay and Nash, *Biophysical Chemistry*, Himalaya Publishing House. 3rd Ed., 1997.

E-Resources

1. https://nptel.ac.in/courses/104/101/104101094/
2. https://nptel.ac.in/courses/104/102/104102009/
3. https://nptel.ac.in/courses/104/108/104108078/
4. https://nptel.ac.in/courses/104/106/104106048/
5. http://web.mit.edu/8.13/www/JLExperiments/JLExp13.pdf

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students admitted during the Academic Year 2021-22and after)

PART – III **: Core Lab**		SEMESTER **-III**
Course Title: **INORGANIC QUANTITATIVE ESTIMATION**		
Course Code: **33CP34**	Hours per week: **5**	Credits:**4**
CIA Marks: **40 Marks**	ESE Marks: **60 Marks**	Total Marks: **100 Marks**

Preamble

- ✓ Students are enabled to
- ✓ Estimate the amount inorganic salt present in the whole of the given solution.
- ✓ Experience hands on training in different types of titration.

Course Outcomes (CLO)

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Demonstrate the complexometric titration	K2
CLO2	Interpret the principles and terminology involved in volumetric estimation	K2
CLO3	Understand the principles of gravimetric estimation	K3
CLO4	Estimate the amount of Barium, Iron and Copper, by Volumetrically	K3
CLO5	Estimate the amount of Nickel, Magnesium and Zinc, by Gravimetrically	K3

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Syllabus

UNIT-I: COMPLEXOMETRIC TITRATION

1. Estimation of zinc.
2. Estimation of magnesium.

UNIT-II:

1. Estimation of copper.
2. Estimation of nickel.

a) By direct method. b) By indirect method.

UNIT-III:

The first metal ion should be estimated by volumetric and the second by gravimetric:

1. Estimation of copper and nickel.
2. Estimation of calcium and magnesium.

UNIT-IV

1.Estimation of barium and zinc.

2. Estimation of iron and nickel.

UNIT-V

1. Estimation of copper and zinc..

Reference Books

1. Vogel, A.I. *Elementary Practical Inorganic Chemistry*, (Fourth Edition) -Longmann London, 1987.
2. Thomas, A.O. *B.Sc. Main Practical Chemistry*, Scientific Book Centre, Cannanore, 2003.
3. Venkateswaran, V., Veerasamy, R. and Kulandaivelu, A.R. *Basic Principles of Practical Chemistry*, 2nd Ed., Sultan Chand and Sons, New Delhi, 2017.

E-Resources

1. https://www.youtube.com/watch?v=-BRCurEffmk
2. https://www.youtube.com/watch?v=CTuKSS7gLmY
3. https://www.youtube.com/watch?v=VLT3uv97dYk
4. https://www.youtube.com/watch?v=n2Bp3gz1V0o
5. https://www.youtube.com/watch?v=8mK9QASlYLM

Distribution of marks

Max marks: 100

Internal	**: 40 marks**	**External**	**: 60 marks**
Attendance	: 5 marks	Volumetric analysis	: 20 marks
Laboratory performance and model practical	: 20 marks	Gravimetric estimation	: 20 marks
		Record note book	: 10 marks
Viva-voce	: 5 marks	Viva-voce	: 10 marks
Observation note book	: 10 marks		
Total	: 40 marks	Total	: 60 marks

Volumetric analysis (20 marks)		**Gravimetric Estimation (20 marks)**	
Procedure	: 5 marks	Procedure	: 5 marks
Estimation	: 15 marks	Estimation	: 15 marks
Less than 2 % Error	: 15 marks	Less than 2 % Error	: 15 marks
2-3% Error	: 14 marks	2-3% Error	: 14 marks
2-3% Error	: 12 marks	2-3% Error	: 12 marks
2-3% Error	: 10 marks	2-3% Error	: 10 marks
Greater than 5% Error	: 8 marks	Greater than 5% Error	: 8 marks

DEPARTMENT OF CHEMISTRY

Programme: M.Sc./M. Com Except Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – IV**: Non Major Elective**		SEMESTER **III**
Course Title: **FORENSIC CHEMISTRY**		
Course Code: **33NE31**	Hours per week: **5**	Credits: **5**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Understand the disciplines of forensic chemistry and various divisions in central forensic laboratory.
- ✓ Explain the basic techniques and analysis of forensic chemistry.
- ✓ Have knowledge on autopsy and death investigation procedures.

Course Outcomes (CO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Name and explain the disciplines in forensic chemistry and divisions in central forensic laboratories.	K1 & K2
CLO2	Explain and utilize the diverse techniques for crime investigation	K2 & K3
CLO3	Illustrate and examine the role of forensic scientist and study the theory behind variety of analysis.	K2 & K4
CLO4	Relate the concept of different blood groups and apply to paternity blood tests.	K1 & K3
CLO5	Recall, demonstrate and analyze the documentation and reports of postmortem.	K1,K2 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Syllabus

UNIT-I: FORENSIC DISCIPLINES

Forensic science disciplines: pathology – anthropology – entomology – odontology – toxicology – psychiatry – various divisions in central forensic science laboratory: biology – serology – physics – ballistics – documents – chemistry – fingerprint – lie detection – photo and scientific aids.

UNIT-II: FORENSIC TECHNIQUES

Introduction – narco-analysis test – polygraph/lie detector test – modern advances in recognition of dishonesty – brain mapping – DNA-profiling – paternity – fingerprints types – brain and ballistic fingerprinting – other techniques – relation with crime investigation – an analysis.

UNIT-III: FORENSIC ANALYSIS

Role of a forensic scientist – forensic generalist and specialist – theory of forensic analysis – classification and individualization of a crime – fingerprint development – presumptive drug analysis – crime incident soil analysis – size, density, pH comparison of microscopic analysis.

UNIT-IV: FORENSIC SEROLOGY

Definiton – expert – blood stain pattern analysis – blood flight characteristics – transfer and spatter – its three types: low, medium and high force velocity impact spatter – target surface texture – blood group – paternity blood tests – semen identification and presumptive tests.

UNIT-V: FORENSIC AUTOPSY

Medicolegal death investigation – forensic autopsies – identification procedures – disposition of unidentified bodies – external examination: general and specific procedures – internal examination – ancillary and support services – documentation and reports of postmortem.

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Reference Books

1. Nbabr, B.S. *Forensic Science*, SVP national police academy, Hyderabad, 2005.
2. James, T.H. *Forensic Sciences*, Stanley Thomas Ltd., 2000.
3. Richard, *Criminalistics- An introduction to forensic science*, 8th Ed., sofestein, Prince Hall, 2006.
4. Nanda and Tewari, *Forensic Science in India- A vision for the 21st century*, select publisher, 2001.

E-Resources

1. http://index-of.es/Varios 2/Forensic%20Chemistry%20Fundamentals%20and%20Applications.pdf
2. https://ifflab.org/branches-of-forensic-science/
3. https://www.precisa.co.uk/precision-weighing-in-forensic-analysis-forensic-processes-and-forensic-lab-equipment/
4. https://www.njsp.org/division/investigations/forensic-serology.shtml
5. https://www.youtube.com/watch?v=BhgazgHwt-Y

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **IV**
Course Title: **ORGANIC CHEMISTRY - IV**		
Course Code: **33CC41**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Understand organic chemical reactions involving structural changes.
- ✓ Know various organic protection and deprotection reagents in organic synthesis.
- ✓ Know various strategies used in retro synthetic analysis.
- ✓ Understand synthetic aptitude on the heterocyclic compounds.
- ✓ Know the chemistry of selected steroids and hormones

Course Outcomes (CO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Outline and examine the free radical processes of synthesis and rearrangement mechanisms of reactions in organic chemistry	K2 & K4
CLO2	List, apply and analyze the concept of protection and deprotection of functional groups	K1, K3 & K4
CLO3	Demonstrate and construct the synthetic strategy of organic compounds	K2 and K4
CLO4	Relate and explain the chemistry and reactions of heterocyclic compounds	K1 & K2
CLO5	Demonstrate and examine the chemistry of cholesterol and oxytocin	K2 & K2

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	1	3	1	3
CLO 2	9	1	3	1	3	1	3
CLO 3	9	1	3	1	3	1	3
CLO 4	9	1	3	1	3	1	3
CLO 5	9	1	3	1	3	1	3
Weightage of the course	45	5	15	5	15	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	1	1	1	3
CLO 2	9	3	9	1	3
CLO 3	3	1	1	1	1
CLO 4	3	1	9	9	1
CLO 5	9	3	3	3	3
Weightage of the course	33	9	23	15	11

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: FREE RADICAL REACTIONS AND MOLECULAR REARRANGEMENTS

FREE RADICAL REACTIONS: Allylic halogenation – *N*-Bromosuccinimide (NBS) –oxidation of aldehydes to carboxylic acids – auto-oxidation – coupling of alkynes and arylation of aromatic compounds by diazonium salts – Sandmeyer reaction – free radical rearrangement – Hunsdiecker reaction.

MOLECULAR REARRANGEMENTS: Hoffmann – Schmidt – Lossen – Curtius – Beckmann – Fries – Favorskii – Baeyer-Villiger rearrangements.

UNIT-II: PROTECTION AND DEPROTECTION CHEMISTRY IN ORGANIC SYNTHESIS

Protection and cleavage of hydroxyl groups (by ethers): Chloromethoxymethyl ether (MOM-Cl) – chloromethoxyethoxymethyl ether (MEM-Cl) – tetrahydropyranyl ether (THP), allyl, benzyl, *t*-buthyldimethylsilyl ether (TBDMS).

Protection and cleavage of hydroxyl groups (by esters): Trichloroacetate – phenoxyacetate – pivaloate – 2,4,6-trimethylbenzoate.

Protection and cleavage of 1,2 and 1,3-Diols-methylene dioxyderivative: Methoxy methylene acetal – ethyledineacetal – cyclic carbonates.

Protection and cleavage of carbonyl groups: 1,3-dioxanes – 1,3-dithianes – 2,4-dinitrophenyl hydrazones.

Protection and cleavage of Amino groups: t-butyl carbamate (Boc), benzyl carbamate (CBz), 9-fluorenylmethyl carbamate (Fmoc), N-acetyl, N-benzyl.

UNIT-III: RETERO SYNTHETIC ANALYSIS

Synthons (nucleophilic and electrophilic synthons) and synthetic equivalents – disconnection approach – functional group interconversion of halides, nitriles, azides, amines, and esters – importance of order of events in organic synthesis – linear and convergent synthesis –umpolung reactions – one group disconnections: alcohol, olefin, ketone, acids – two group disconnections – 1,2- and 1,3-difunctionalised compounds – α and β unsaturated carbonyl compounds – 1,4-difuctionalised compounds – Diels-Alder reaction and Michael addition.

UNIT-IV: HETEROCYCLIC COMPOUNDS

Heterocyclics – nomenclature – compounds containing two hetero atoms: synthesis and reactivity of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, quinoline and isoquinoline – diazines: the

chemistry of pyridazine, pyrimidine and pyrazine – comparison of basicity of diazines – chemistry of anthrocyanins and flavonoids.

UNIT-V: STEROIDS AND HORMONES

STEROIDS: Classification – configurational and conformational aspects of cis-trans steroids – synthesis of cholesterol – conversions of cholesterol to androsterone, testosterone, progesterone and bile acids.

HORMONES: Chemistry and structure of oxytocin.

Reference Books

1. Sanyal, S.N, *Reactions, Rearrangements and Reagents*, BharatiBhavan, 4th Ed., 2013.
2. Mukheriji, Mm and Singh, S.P, *Reaction mechanism in organic chemistry*, Macmillan India Ltd, 3rd Ed., 1998.
3. Clayden, Greeves, Warren and Worthers, *Organic Chemistry*, OXFORD University Press, 2nd Ed., 2007.
4. Norman, R.O.C, and Coxon, J.M, *Principles of Organic Synthesis*, CRC Press, 3rd Ed., 2012.
5. Wyatt, P. and Warren, S. *Organic Synthesis: Strategy and Control*, Wiley, Publications, 2013.
6. Warren, S. and Wyatt, P. *Organic Synthesis:The Disconnection Approach*, John Wiley & amp; Sons, 2nd Ed., 2008.
7. Jerry March, *Advanced organic Chemistry – Reactions, Mechanism and structure*, John Wiley and sonspvt.Ltd. 4th Ed., 2007.
8. Finar, I.L. *Organic Chemistry*, Vol. II, ELBS, 5th Ed., 1974.
9. Agarwal, O.P. *Chemistry of organic Natural products*, Vol. I 34th and II 37th Ed., GOEL publishing House, Meerut. 2008.
10. Ireland, R.E. *Organic Synthesis*, Prentice Hall of India Pvt. Ltd., 1975.

E-Resources

1. https://www.youtube.com/watch?v=HUyST6oLSoY
2. https://www.youtube.com/watch?v=iKOEd2Rlz5M
3. https://www.youtube.com/watch?v=uqF5JoU-YRQ
4. https://www.youtube.com/watch?v=uvjVY2SYejw
5. https://www.youtube.com/watch?v=0yPBkxy6m9A3.

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **IV**
Course Title: **INORGANIC CHEMISTRY - IV**		
Course Code: **33CC42**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Understand the basics of solid state chemistry
- ✓ Discuss the photochemical reactions of inorganic complexes.
- ✓ Develop problem solving skills from various type of spectra.
- ✓ study in detail the fundamental aspects of various instrumental methods in chemistry

Course Outcomes (CO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Demonstrate, construct and categorize the different solid state structures of inorganic solids	K2, K3 & K4
CLO2	Summarize the various crystal defects and organize electronic structure of conductors, insulators and semiconductors	K2 & K3
CLO3	Apply and analyze the basics of photochemistry in inorganic compounds in various energy storage and conversion processes.	K3 & K4
CLO4	Relate, explain and examine the concepts and applications of ^{13}C, ^{9}F, ^{31}P NMR, ESR and Mossbauer spectra	K1, K2 & K4
CLO5	Demonstrate and apply various analytical methods for characterization	K2 & K3

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO 1	9	1	3	1	3	1	3
CLO 2	9	1	3	1	3	1	3
CLO 3	9	1	3	1	3	1	3
CLO 4	9	1	3	1	3	1	3
CLO 5	9	1	3	1	3	1	3
Weightage of the course	45	5	15	5	15	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	3	3
CLO 2	9	9	3	3	3
CLO 3	9	9	3	3	3
CLO 4	9	9	3	3	3
CLO 5	9	9	3	3	3
Weightage of the course	45	45	15	15	15

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: SOLID STATE CHEMISTRY – I

Cells and description of crystal structure – close packing of spheres – packing efficiency – hexagonal close packed (HCP), cubic closed packing (CCP), body centered cubic (BCC) structures – coordination number – relative density of packing – relative density of packing in simple cubic, CCP, HCP and BCC – tetrahedral and octahedral holes – Limiting radius ratio rule – radius ratio for trigonal, tetrahedral, octahedral and cubic sites – radius ratio and shape of ionic crystals – structures of cesium chloride, sodium chloride, zinc blende, fluorite, rutile and calcite.

UNIT-II: SOLID STATE CHEMISTRY – II

X-ray diffraction – derivation of Bragg's equation – experimental method (rotating crystal and powder) – X-ray diffraction patterns of a cubic system – X-ray diffraction patterns for tungsten crystal – electron diffraction – neutron diffraction.

Defects: Stoichiometric defects – Schottky and Frenkel defects – non-stoichiometric defects – metal excess and metal deficiency defects – extended defects – line and plane defects.

Band theory: Semiconductors – intrinsic and extrinsic type – Fermi level – flow of current in semiconductors – band structure of conductors, insulators and semiconductors – p and n type semiconductors – p-n junction – introduction of superconductors.

UNIT-III: INORGANIC PHOTOCHEMISTRY

Principle of light absorption – physical and chemical processes – bimolecular reactions – Stern-Volmer relationship – properties of d-d, d-π*, π-π* and π-d energy states – photochemical reactions of metal complexes – substitution – Adamson's rule – rearrangement – isomerization – racemization – aquation and anation – redox reactions.

Ruthenium polypyridyls – excited state properties – electron transfer and energy transfer quenching reactions – importance of solar energy conversion and storage – cleavage of water using $[Ru(bpy)]^{2+}$, cadmium sulphide colloidal particles and titanium dioxide semiconductor.

UNIT-IV: APPLICATION OF SPECTROSCOPY TO INORGANIC COMPOUNDS

Nuclear magnetic resonance (NMR):

Classification of the spinning nuclei – applications in structure determination of carbon-13 (cis and trans isomers of $[RuCl(NO)(bpy)_2]^+$ – phosphorus-31 (HPF_2, H_3PO_3 and $Rh(PPh_3)Cl_3$) – fluorine-19 (ClF_3, ClF_5,

PF_5 and XeF_6) – boron compounds (B_2H_6 and $(CH_3)_4B_2H_2$) – NMR spectrum of paramagnetic complexes ($Ru_2Cl_4(CO)(PPh_3)_4$– contact shifts.

Electron spin resonance (ESR):

Application to transition metal complexes – [d^1-VO(II), d^5 low spin-$[Fe(CN)_6]^{3-}$, d^5 high spin-Mn(II), d^7 high and low spin-Co(II), d^8-Ni(II) and d^9-Cu(II)] – bissalicylaldiminecopper(II) complexes.

Mossbauer spectroscopy (MB):

Applications to metal carbonyls: $Fe(CO)_5$, $Fe_2(CO)_9$ and $Fe_3(CO)_{12}$ – nitrosyls (sodium nitroprusside) – tin complexes – characterization of magnetic state.

UNIT-V: ANALYTICAL METHODS IN CHEMISTRY

Principles and applications of coulometry, amperometry and cyclic voltammetry – thermal characterization techniques: principle and applications of Differential thermal analysis (DTA), Differentials scanning calorimetry (DSC) and Thermogravimetric analysis (TGA) – thermometric titration.

Reference Books

1. Huheey, J.E., Keiter, E.A. and Keiter, R.L. *Inorganic Chemistry: Principles of structure and reactivity*, 4th Ed., Pearson Education Pte. Ltd., Delhi, 2004.
2. Atkins, P.W., Overton, T.L., Rourke, J. P., Weller, M.T. and Armstrong, F.A. *Inorganic Chemistry*, 5th Ed., Oxford University Press, 2010.
3. Azaroff, L.V. *Introduction to Solids*, (TMH edition) Tata. Mc.Graw Hill, 1977.
4. West, A.R. *Basic Solid State Chemistry*, 2nd Ed., Wiley, 1999.
5. West, A.R. *Solid State Chemistry and its Application*, 2nd Ed., Wiley, 2007.
6. Rohatgi, K.K. and Mukherjee, K.K. *Fundamentals of Photochemistry*, New Age International Publisher, New Delhi, 2006.
7. Drago, R. *Physical Methods in Inorganic Chemistry*, An East West press, 1971.
8. Abdul Jameel, A. *Application of Physical methods to Inorganic compounds*, 2nd Ed., JAN publications, Tiruchirappalli, 2012.
9. Skoog, D.A., West, D.M. and Holler, F.J. *Fundamentals of Analytical Chemistry*, 7th Ed., Harcourt Asia (P) Ltd, 1995.
10. Sharma, B.K., *Instumental techniques for analytical Chemistry*, Editor – Prentice Hall Inc. 1997.

E-Resources

1. https://nptel.ac.in/courses/104/108/104108098/
2. https://nptel.ac.in/courses/104/104/104104101/
3. https://research.cbc.osu.edu/turro.1/wp-content/uploads/2017/10/1993_Adamson.pdf
4. https://nptel.ac.in/courses/104/108/104108124/
5. https://nptel.ac.in/courses/104/106/104106048/

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Core Theory**		SEMESTER **IV**
Course Title: **PHYSICAL CHEMISTRY - IV**		
Course Code: **33CC43**	Hours per week: **5**	Credits: **4**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are able to
understand list, explain and examine the principles and applications of the electrochemistry, statistical thermodynamics and chemistry of polymer

Course Outcomes (CO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Define and explain the basic idea of the electrochemistry	K1 & K2
CLO2	List, explain and examine the principles and applications of the electrochemistry	K1, K2 & K4
CLO3	Understand and apply the basic concept of statistical thermodynamics	K1,K2,K3& K4
CLO4	Develop and examine the concept of statistical thermodynamics	K3 & K4
CLO5	List, understand and analyze the chemistry of polymer	K1, K2 & K4

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO 1	9	1	3	1	3	1	3
CLO 2	9	1	3	1	3	1	3
CLO 3	9	1	3	1	3	1	3
CLO 4	9	1	3	1	3	1	3
CLO 5	9	1	3	1	3	1	3
Weightage of the course	45	5	15	5	15	5	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	9	3	3	3
CLO 2	9	9	3	3	3
CLO 3	9	9	3	3	3
CLO 4	9	9	3	3	3
CLO 5	9	9	3	3	3
Weightage of the course	45	45	15	15	15

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: ELECTROCHEMISTRY – I

Electrode – electrolyte interfaces – polarisable and non-polarisable interfaces – structure of electrical double layer – electro capillary and double layer capacity measurements – double layer models – Helmholtz, Gouy–Chapman and Stern models – specific adsorption of ions and molecules – kinetics of electrode process – current–potential curves – Butler-Volmer relation and its approximations – Tafel relation – charge transfer resistance – Nernst equation from Butler-Volmer equation – electro catalysis.

UNIT-II: ELECTROCHEMISTRY – II

Over voltage – theories of overvoltage – bubble formation – combination of atoms – ion discharge – proton transfer – applications of overvoltage – principles, instrumentation and applications of polorography – principles, instrumentation of cyclic voltammetry – general discussion of the cyclic voltammograms of one electron reversible process (potassium ferrocyanide / potassium ferricyanide) – irreversible one electron transfer process and quasi reversible reactions – hydrogen-oxygen fuel cell.

UNIT-III: STATISTICAL THERMODYNAMICS – I

Aim of statistical thermodynamics – definition of state of a system – ensembles and micro ensembles – micro-canonical and canonical – Boltzmann distribution law and its derivation – population inversion – absolute negative Kelvin temperature – Boltzmann-Planck equation – partition functions – thermodynamic properties from partition function and equilibrium constant.

UNIT-IV: STATISTICAL THERMODYNAMICS – II

Quantum statistics – Fermi-Dirac and Bose-Einstein statistics – photon gas – electron gas according to such statistics – heat capacity of diatomic gases including hydrogen molecule – Einstein and Debye theories of heat capacities of solids.

UNIT-V: POLYMERS

Introduction – structures of polymers – kinetics and mechanisms of polymerization - free radical, ionic and coordination polymerization **–** Ziegler-Natta catalysis – condensation polymerization – degree of polymerization – chain length – copolymerization – determination of molecular weight – light scattering, viscosity methods – process of polymerization – bulk solution, suspension and emulsion polymerization – polymer additives – use of fillers in plastics **–** conducting polymers.

Reference Books

1. Bockris and Reddy, *Electrochemistry*, Vol I and II, Rosetta edition, 2002.
2. Kuriacose and Rajaram, J. *Thermodynamics,* Shoban Lal Nagin Chand, 1993.
3. Gowariker, V.R., Viswanathan N.V. and Jeyadev Sreedhar, *Polymer science*, Wiley, 1986.
4. Glasstone, *Introduction to electrochemistry*, 1993.
5. Crow, *Principles and applications of Electrochemistry*, Chapman and Hall, 1988.
6. Castellan, *Physical chemistry*, Addision Wesley, 1983.
7. Hill, Addision–Wesley. *Introduction to statistical thermodynamics*, 3rd Ed,.1983.
8. Moore, W. J. *Physical chemistry*, 5th Ed., Orient Longmans, 1976.
9. Daniels and Alberty, *Physical chemistry*, John Willey & sons, 1993.
10. Billmeyer. J.V. *Textbook of polymer science,* Wiley.1984
11. Allcock and Lampc, P.W. *Contemporary polymer chemistry,* Prentice Hall, 1981.

E-Resources

1. https://nptel.ac.in/courses/104/106/104106105/
2. https://nptel.ac.in/courses/103/106/105106204/
3. https://nptel.ac.in/courses/104/103/104103112/

4. https://nptel.ac.in/courses/104/106/104106107/
5. https://nptel.ac.in/courses/113/105/113105028/

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Elective Theory**		SEMESTER **IV**
Course Title: **CHEMISTRY FOR NATIONALITY ELIGIBILITY TEST**		
Course Code: **33EP4A**	Hours per week: **5**	Credits: **5**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ trained to face entrance examinations for admission towards Research
- ✓ to compete the entrance examinations conducted by CSIR,TNPSC, SET, GATE and private industries.

Course Outcomes (CO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	Interpret and make use of the basic knowledge in organic chemistry to solve the problems on IUPAC nomenclature, aromaticity, stereochemistry, common organic reactions, synthesis and their mechanisms	K2 & K3
CLO2	Relate and analyze the selected naming reactions, organic rearrangements, some important catalysts and specific synthetic reagents in the organic synthesis	K2 & K4
CLO3	Explain and examine the important concepts like chemical periodicity, main group elements, inner transition elements and organometallic compounds	K2 & K4
CLO4	Make use of the analytical techniques and analyze it for the characterization of organic and inorganic compounds	K3 & K4
CLO5	Understand and apply basic ideas in selected physical chemistry topics like quantum mechanics, group theory, thermodynamics, electrochemistry, chemical kinetics, catalysis, colloids & surfaces and polymer chemistry	K2 & K3

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	3	3	1	3
CLO 2	9	1	3	3	3	1	3
CLO 3	9	1	3	3	3	1	3
CLO 4	9	1	3	3	3	1	3
CLO 5	9	1	3	3	3	9	3

Weightage of the course	45	5	15	15	15	13	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CLO 1	9	1	1	1	3
CLO 2	9	3	9	1	3
CLO 3	3	1	1	1	1
CLO 4	3	1	9	9	1
CLO 5	9	3	3	3	3
Weightage of the course	33	9	23	15	11

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I

IUPAC nomenclature: IUPAC nomenclature of organic molecules including regio- and stereoisomers.

Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.

Organic reactive intermediates: Generation, stability and reactivity of carbocations – carbanions – free radicals – carbenes – benzynes – nitrenes.

Principles of stereochemistry: Configurational and conformational isomerism in a cyclic and cyclic compound – stereoselective, stereospecific, regioselective and regiospecific reactions – asymmetric synthesis – homotopic, enantiotopic and diastereotopic atoms – groups and faces

Reaction Mechanisms: Basic mechanistic Concepts – kinetic *versus* thermodynamic control – Hammond's postulate and Curtin-Hammett principle – nucleophilic and electrophilic substitution reactions – addition reactions to carbon-carbon multiple bonds.

Organic Synthesis: Carbon-carbon bond formation – Heck, Suzuki, Stille and Sonogoshira – retrosynthesis – disconnection – synthons – linear and convergent synthesis – umpolung of reactivity – protecting and deprotecting groups – carbon-carbon bond forming reactions through enolates (including boron and silicon enolates) – enamines and silyl enol ethers – Michael addition reaction – stereoselective addition to C=O groups.

UNIT-II

Common named reactions, rearrangements, catalystsand reagents

Pericyclic Reactions and Photochemistry: Electrocyclic, cycloaddition and sigmatropic reactions – orbital correlations – FMO and PMO treatments – photochemistry of alkenes, arenes and carbonyl compounds – Norrish type I and II reactions – Paterno-Buchi reaction – photooxidation and photoreduction – di-π methane rearrangement – Barton reaction.

Heterocyclic Compounds: Structure, preparation, properties and reactions of furan – pyrrole – thiophene – pyridine – indole – quinoline and isoquinoline.
Chemistry of Natural Products: Carbohydrates – proteins and peptides – fatty acids –nucleic acids – terpenes – steroids and alkaloids
Spectroscopy: Applications of UV-Visible, IR, NMR and Mass spectrometry in the structural determination of organic molecules.

UNIT-III

Chemical periodicity: Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory) – various concepts of acids and bases.
Main group elements and their compounds: Allotropy – synthesis – structure and bonding – industrial importance of the compounds – transition elements and coordination compounds: structure, bonding, spectral and magnetic properties – reaction mechanisms.
Inner transition elements: Spectral and magnetic properties – redox chemistry – analytical applications.
Organometallic compounds: Synthesis, bonding, structure, and reactivity – organometallics in homogeneous catalysis – cages and metal clusters.

UNIT-IV

Analytical chemistry: Separation, spectroscopic, electro- and thermoanalytical methods.
Bioinorganic chemistry: Photosystems, porphyrins, metalloenzymes, oxygen transport, electron – transfer reactions – nitrogen fixation – metal complexes in medicine.
Characterisation of Inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-Vis, NQR, MS, electron spectroscopy and microscopic techniques.
Nuclear chemistry: Nuclear reactions – fission and fusion – radio-analytical techniques and activation analysis.

UNIT-V

Basic principles of quantum mechanics: Schrodinger equation – particle in a 1D box – harmonic oscillator – variational and perturbational methods.
Chemical applications of group theory: Point group – character tables – reducible and irreducible representations and applications – basic principles and application of spectroscopy – rotational, vibrational, electronic, Raman, ESR, NMR.
Chemical thermodynamics: Various law – state and path functions and their applications –Maxwell's relations – spontaneity and equilibria – temperature and pressure dependence of thermodynamic quantities – Le Chatelier principle – elementary description of phase transitions – phase equilibria and phase rule – thermodynamics of ideal and non-ideal gases and solutions.
Statistical thermodynamics: Boltzmann distribution – kinetic theory of gases – partition functions and their relation to thermodynamic quantities – calculations for model systems.
Electrochemistry: Nernst equation – electrode kinetics – electrical double layer – Debye-Hückel theory – Kohlrausch's law and its applications.
Chemical kinetics: Empirical rate laws – Arrhenius equation – theories of reaction rates – determination of reaction mechanisms – experimental techniques for fast reactions.
Catalysis: Homogenous and Heterogeneous catalysis – Hammett acid-base catalysis – rate of acid and base catalysis – Enzyme catalysis.
Colloids and surfaces: Stability and properties of colloids – isotherms and surface area – Solids – structural classification of binary and ternary compounds – diffraction techniques – bonding, thermal, electrical and magnetic properties.
Polymer chemistry: Molecular weights and their determinations – kinetics of chain polymerization.

Reference Books

1. Clayden, J., Greeves, N., Warren, S., Wothers, P. *Organic Chemistry*, 2nd Ed., Oxford University Press, 2014.

2. Carruthers, W. and Coldham, I. *Modern Methods of Organic Synthesis*, 4th Ed., Cambridge University Press, 2006.
3. Francis A. Carey, Richard J. Sundberg, *Advanced Organic Chemistry, Part-A: Structure and Mechanism*, 5th Ed., Springer, New York, 2008.
4. Smith, M.B. and March, J. *Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*, 6th Ed., Wiley, 2007
5. Eliel, E.L., and Wilen, S.H., *Stereochemistry of Organic Compounds*, 1st Ed., John Wiley and Sons, 1994
6. Kalsi, P.S. *Stereochemistry, Conformation and Mechanism*, 4th Ed., Wiley Eastern Ltd 2006.
7. Nasipuri, D. *Stereochemistry of Organic Compounds, Principles and Application*, 2nd Ed., Wiley Eastern Ltd., 2006.
8. Pavia, D.L., Lampman, G.M., and Kriz, G.A. *Introduction toSpectroscopy*, 4th Ed., Cengage Learning, 2009.
9. Mukheriji, S.M. and Singh, S.P. *Reaction Mechanism in Organic Chemistry*, 3rd Ed., Macmillan India Ltd, 1998.
10. Jagdamba Singh and Jaya Singh, *Photochemistry and Pericyclic Reactions*, 3rd Ed., New Age International Publishers Ltd., New Delhi, 2012.
11. Finar, I.L. *Organic Chemistry, Volume 2: Stereochemistry and the Chemistry Natural Products*, 5th Ed., Pearson, 2002.

Inorganic chemistry:

1. Tarr, D.A., Miessler, G.L., *Inorganic Chemistry*, 5th Ed., 2013.
2. Huheey, J.E. *Inorganic Chemistry: Principles of Structure and Reactivity* 4th Ed., Pearson Education, 2007.
3. Shriver, D.F. and Atkins, P.W. *Inorganic Chemistry*, 1st Ed., Oxford University Press, 1993.
4. Jeffery, G.H., Bassett, J., Mendnam, J. and Denney, R.C. *VOGEL's Text book of Quantitative Chemical Analysis*, 5th Ed., Addison-Wesley Longman Inc, 1989.
5. Douglas, A.S., Donald, M. *Fundamentals of Analytical Chemistry*, 7th Ed., Harcourt Asia (P) Ltd, Asia, 1995.
6. Sharma, B.K. *Instrumental Techniques for Analytical Chemistry*, Editor – Prentice Hall Inc, 1997.

Physical chemistry:

1. Glasstone, *Introduction to Electrochemistry*, 1993.
2. Bockris and Reddy, *Electrochemistry*, Vol I and II, Rosetta Edition., 2002.
3. Crow, Chapman and Hall. *Principles and Applications of Electrochemistry*, 1988.
4. Kuriacose and Rajaram, J. *Thermodynamics*, Shoban Lal Nagin Chand.,1993.
5. Castellan, *Physical chemistry*, Addision Wesley., 1983.
6. Hill, *Introduction to Statistical Thermodynamics*, 3rd Ed., Addision–Wesley, 1983.
7. Walter J.M. *Physical Chemistry*, 5th Ed., Orient Longmans, 1976.
8. Daniels and Alberty, *Physical Chemistry*, John Willey and sons, 1993.
9. Billmeyer. J.V. *Textbook of Polymer Science*, Wiley, 1984.
10. Allcock and Lampc, P.W. *Contemporary Polymer Chemistry*, Prentice Hall, 1981.
11. Gowariker, V.R., Viswanathan N.V., and JeyadevSreedhar. *Polymer Science*, Wiley,1986.

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1. https://www.adichemistry.com/general/general-chemistry.html
2. https://ifasonline.com/csir-net-chemical-science-study-material.jsp
3. http://edujournal.in/csir-net-jrf-chemical-science-solved-paper-by-upkar-publication-download-free-pdf/

DEPARTMENT OF CHEMISTRY

Programme: M.Sc. Chemistry, (CBCS and LOCF)

(For those students who admitted during the Academic Year 2021-22and after)

PART – III**: Elective Theory**		SEMESTER **IV**
Course Title: **INTRODUCTION TO NANOSCIENCE**		
Course Code: **33EP4B**	Hours per week: **5**	Credits: **5**
CIA Marks: **25 Marks**	ESE Marks: **75 Marks**	Total Marks: **100 Marks**

Preamble

Students are enabled to

- ✓ Gain depth knowledge about the preparation, properties and characterization of nanomaterials
- ✓ Know the principle and instrumentation of XRD, EXAFS , XPS , SEM , TEM and AFM
- ✓ Understand about the importance of biological nanomaterials

Course Outcomes (CO)

On the successful completion of the course, students will be able to

No.	Course learning outcome	Knowledge Level (according to Bloom's Taxonomy)
CLO1	List, classify and analyze the basic properties of nanomaterials	**K1, K2 & K4**
CLO2	Demonstrate and construct the synthesis of nanomaterials	**K2& K3**
CLO3	Relate, summarize and apply the principle and instrumentation for the characterization of nanomaterials	**K1, K2&K3**
CLO4	Apply and analyze the optical properties of nanomaterials	**K3 &K4**
CLO5	Interpret, organize and examine the importance of biological nanomaterials	**K2, K3 & K4**

K1-Remembering K2-Understanding K3-Applying K4-Analyzing

Mapping of CLO with PLO

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**
CLO 1	9	1	3	3	3	1	3
CLO 2	9	1	3	3	3	1	3
CLO 3	9	1	3	3	3	1	3
CLO 4	9	1	3	3	3	1	3
CLO 5	9	1	3	3	3	9	3
Weightage of the course	45	5	15	15	15	13	15

9-Strong; 3-Medium; 1-Low

Mapping of CLO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	9	1	1	1	3
CLO 2	9	3	9	1	3
CLO 3	3	1	1	1	1
CLO 4	3	1	9	9	1
CLO 5	9	3	3	3	3
Weightage of the course	33	9	23	15	11

9-Strong; 3-Medium; 1-Low

Syllabus

UNIT-I: GENERAL INTRODUCTION

Forms of matter – crystal structures – electronic properties of atoms and solids – surface energy and surface tension – defining nano dimensional materials – 0D, 1D and 2D nanostructures – size dependence of properties – special properties resulting from nano dimensionality – potential uses of nanomaterials.

UNIT-II: SYNTHESIS OF NANOMATERIALS

General approaches – nucleation process – size of the crystal – influence of nucleation rate on the size of the crystal – chemical methods – sol-gel techniques – control of grain size – Co-precipitation – hydrolysis – sonochemical method – colloidal precipitation – bottom up and top down approaches – kinetically confined synthesis of nanoparticles.

UNIT-III: PRINCIPLE AND INSTRUMENTATION

Principle, instrumentation and applications of XRD, EXAFS, XPS, SEM, TEM, AFM – application to nanomaterials characterization.

UNIT-IV: OPTICAL PROPERTIES OF NANOMATERIALS

UV-Vis, IR absorption – photoluminescence and stimulated emission – nonlinear optical mixing – photoconductivity – magnetic properties: concepts of dia, para, and ferro-magnetism – exchange correlation – exchange interaction.

Electrical properties: Electrical conductivity – Hall effect – charge carrier density – activation energy – electronic properties – field emission properties.

UNIT-V: BIOLOGICAL NANOMATERIALS

Sizes of building blocks – proteins – DNA double nanowire – enzymes – protein synthesis – micelles and vesicles – biomimetic nanostructures – worm micelles and vesicles from block copolymers.

Reference Books

1. Poole, C.P. and Owens, F.K. Jr., *Introduction to Nanotechnology* , John Wiley & Sons, 2003.
2. Ventra, M.D., Evoy, S. and Heflin, J.R. Jr., *Introduction to Nanoscale Science and Technology*, Kluwer Academic, 2004.
3. Rao, C.N.R., Muller, A. and Cheetham A.K. *The Chemistry of Nanomaterials: Synthesis, Properties and Applications*, WILEY –VCH Verlag GmbH & Co, KGaA, Weinheim, 2004
4. Schmid, *Nanoparticle: from Theory to Applications*, Wiley VCH Verlag, 2004
5. Dutta, P. and Gupta, S. *Understanding of Nanoscience and Technology*, Global Vision Publishing House,2006
6. Koch, C.C. *Nanostructured Materials: Processing, Properties and Applications*, Jaico Publishing House,2006

7. Challa S.S.R. and Kumar, *Biological and Pharmaceutical Nanomaterials*, John Wiley, 2006.
8. Cao, G. *Nanostructures & Nanomaterials: Synthesis, Properties &Applications*, Imperial College Press, 2004.

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3. http://trl.lab.uic.edu/1.OnlineMaterials/nano.publications/17.An%20Introduction%20to%20%20Nanoscience%20&%20Nanotechnology.pdf
4. https://www.nrel.gov/docs/fy00osti/22211.pdf
5. https://www.nanoshel.com/nanomaterials-synthesis